

REVIEW

—OF—

American Chemical Research

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Contributed by Members of the Instructing Staff of
the Massachusetts Institute of Technology.

ARTHUR A. NOYES, Editor.

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REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. VI. NO. I.

ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

GENERAL AND PHYSICAL CHEMISTRY.

A. A. NOYES, REVIEWER.

The Development and Application of a General Equation for Free Energy and Physico-Chemical Equilibrium. By GILBERT NEWTON LEWIS. *Proc. Am. Acad.*, 35, 1-38.—The title well indicates the general scope of the article, of which a detailed review is impracticable. The following laws and phenomena are considered by the author from the point of view of his general free energy equation: law of mass-action; law of constant distribution-coefficients; change of equilibrium with temperature including van't Hoff's equation; van der Waals' equation; heats of vaporization and vapor-pressure curves; specific heats of liquids and vapors; osmotic pressure of concentrated solutions; distribution of a solute between two solvents; single potential differences and electromotive force of concentration cells and of those composed of the same metal in contact with the same electrolyte dissolved in two different solvents. The mathematical treatment of the author is unusually clear and explicit.

Contribution to Our Knowledge of Aqueous Solutions of Double Salts.—II. *Chlorides*. By HARRY C. JONES AND KENJIRO OTA. *Am. Chem. J.*, 22, 5-14.—III. *Chlorides and Bromides*. By HARRY C. JONES AND NICHOLAS KNIGHT. *Am. Chem. J.*, 22, 110-141.—The electrical conductivity of aqueous solutions, varying in concentration from 0.5-1.0 mol. per liter to a very high dilution, of a considerable number of double chlorides and bromides, was measured and compared with the sum of the conductivities of the separate components of

the double salt, which were in many cases measured by the authors, but in others were taken from Kohlrausch. The following table presents the results in a greatly condensed form. Under *v* is given the volume in liters in which one gram-molecular weight of the double salt is dissolved, and under "per cent. diff." is given the percentage difference (unfortunately not calculated by the authors) between the sum of the conductivities of the separate component salts and the conductivity of the double salt. The four salts in the first horizontal series were investigated by Jones and Ota, the remainder by Jones and Knight.

| $2\text{KCl} \cdot \text{ZnCl}_2$ | | $\text{KCl} \cdot \text{CdCl}_2$ | | $\text{NaCl} \cdot \text{AlCl}_3$ | | $2\text{NH}_4\text{Cl} \cdot \text{HgCl}_2$ | |
|---|-----------------|---|-----------------|-------------------------------------|-----------------|---|-----------------|
| <i>v</i> | Per cent. diff. | <i>v</i> | Per cent. diff. | <i>v</i> | Per cent. diff. | <i>v</i> | Per cent. diff. |
| 1 | 35.8 | 2 | 26.4 | 2.88 | 13.1 | 5 | 12.1 |
| 40 | 2.6 | 32 | 9.7 | 23.04 | 5.2 | 40 | 3.6 |
| 2000 | 0.6 | 1024 | 0.1 | 368.6 | 0.2 | 80 | 1.1 |
| $2\text{NaCl} \cdot \text{ZnCl}_2$ | | $\text{NH}_4\text{Cl} \cdot \text{MgCl}_2$ | | $\text{KCl} \cdot \text{MgCl}_2$ | | $\text{SrCl}_2 \cdot 2\text{CdCl}_2$ | |
| 1.14 | 47.5 | 1.92 | 13.1 | 1.95 | 17.3 | 2.18 | 34.2 |
| 24.16 | 9.4 | 30.72 | 5.0 | 31.2 | 12.5 | 34.9 | 13.6 |
| 773. | 1.8 | 983. | 2.4 | 998. | 5.2 | 1116. | 5.8 |
| $2\text{NaBr} \cdot 3\text{CdBr}_2$ | | $3\text{NH}_4\text{Br} \cdot \text{ZnBr}_2$ | | $\text{BaBr}_2 \cdot \text{CdBr}_2$ | | $\text{KBr} \cdot \text{CdBr}_2$ | |
| 4.88 | 30.6 | 1.6 | 23.2 | 1.97 | 31.8 | .. | .. |
| 39.1 | 14.6 | 25.9 | 7.8 | 31.5 | 9.9 | 30 | 13.7 |
| 1563. | 6.3 | 1039. | 2.4 | 1249. | 3.7 | 1200 | 5.7 |
| $\text{KCl} \cdot \text{NH}_4\text{Cl}$ | | $\text{KCl}_2 \cdot \text{NH}_4\text{Cl}$ | | | | | |
| 1 | 11.9 | 1 | 14.1 | | | | |
| 32 | 3.8 | 32 | 3.7 | | | | |
| 640 | -0.4 | 640 | -0.8 | | | | |

The mixtures of potassium and ammonium chlorides were investigated to determine the effect on one another of two salts which do not form a double salt. In normal solutions of these salts it will be seen that the reduction of the dissociation in the mixture causes a difference in conductivity of 12-14 per cent. The very considerable magnitude of this effect makes somewhat doubtful the general conclusion of the authors that the (other) "double chlorides and bromides exist, to a considerable extent, in the more concentrated solutions, and are completely broken down by water only at very great dilutions." Their conclusion would seem to be warranted in the case of the zinc and cadmium double salts, but not in the case of those of aluminum, mercury, and magnesium. The freezing-point lowering caused by seven of the above double salts was also determined at various dilutions. From the fact that some of these, as well as some of the component salts, exhibit a *minimum* molecular lowering between 0.1 and 0.5 molecular, the authors conclude that the

freezing-point method is not suitable for the investigation of double salts. It would seem to the reviewer, however, that, in spite of the very considerable deviations from theory which no doubt exist, much could be learned from a direct experimental comparison of the component salts and their mixtures, and it is to be hoped that the authors will continue their investigation in this direction.

The Hydrolysis of Stannic Chloride. BY WILLIAM FOSTER, JR. *Phys. Rev.*, 9, 41-56.—The author has determined the electrical conductivity of both concentrated and dilute aqueous stannic chloride solutions, and the increase in their conductivity with the time. He finds that very concentrated solutions (5.0-2.5 equivalents per liter) exhibit no time-change; that solutions of medium concentrations increase slowly in conductivity, while dilute ones (0.5-0.001 normal) change so rapidly that the initial velocity is not measurable. The maximum values reached by the dilute solutions are identical with that shown by hydrochloric acid of the same concentration. These results are substantially the same as those obtained by Goodwin (*this Rev.*, 3, 22) in his similar investigation on ferric chloride. The assumption of complete hydrolysis in dilute solutions is in complete accord with the freezing-point determinations of Loomis, the transference experiments of Hittorf, and the thermochemical measurements of Thomsen.

The Electrical Resistance of Lead Amalgams at Low Temperatures. BY GEORGE W. GRESSMAN. *Phys. Rev.*, 9, 20-29.—The results are presented graphically. As the resistance suddenly decreases very markedly when the amalgam begins to freeze, the freezing-points can be readily determined. These are, for a moderate proportion of lead, *higher* than that of pure mercury; for example, the latter freezes at -38.8° , while a 4.2 per cent. amalgam freezes at -37.7° , a 7.1 per cent. one at -37.0° , and a 11.2 per cent. one at -30.1° .

Molecular Weights of Liquids, III. BY CLARENCE L. SPEYERS. *J. Am. Chem. Soc.*, 21, 282-287.—The author shows graphically that, according to the experiments of Lehfeldt, in the case of mixtures of carbon tetrachloride with benzene and of the same with toluene, the partial vapor-pressure of each constituent is nearly proportional to its percentage molecular concentration, even between the extreme limits of 0 and 100 per cent., but that this is not true of mixtures of ethyl alcohol with benzene or with toluene. He concludes from these facts that the molecules of the constituents of the first-named mixtures are not, and that those of the last-named mixtures are, polymerized.

On Van't Hoff's Equation and the Molecular Weights of Liquids. BY C. L. SPEYERS. *J. Am. Chem. Soc.*, **21**, 725-732.

The Inversion of Sugar by Salts. BY I. KAHLENBERG, D. J. DAVIS, AND R. E. FOWLER. *J. Am. Chem. Soc.*, **21**, 1-23.—The effect of most of the salts investigated by the authors has been determined previously by Walker and Aston (*J. Chem. Soc.*, 67, 576) or by Long (*J. Am. Chem. Soc.*, **18**, 120, 693). The original features of the investigation are the application of the freezing-point lowering as a means of determining the extent of the inversion, and the measurement of the inverting effect of certain colored salts (copper sulphate and chloride and nickel sulphate) by that means. The authors' theoretical considerations in regard to hydrolysis are misleading, this phenomenon depending on the degrees of dissociation of water, of the salt itself, and of the acid and base composing it, and not at all, as the authors state, on the "ionizing tendency" of the separate ions. It may be further pointed out that the inverting effect of a salt of a weak base and the number of hydrogen ions its solution contains are a measure of its hydrolysis only in the case where the acid is completely dissociated; and, therefore, the fact that sulphates of the heavier metals invert less readily than the chlorides, does not necessarily signify a less degree of hydrolysis in the former salts, since much undissociated sulphuric acid may be present.

Derivatives and Atomic Mass of Palladium. BY WILLETT LEPLEY HARDIN. *J. Am. Chem. Soc.*, **21**, 943-955.—Diphenyl-, dipyridine-, and diquinoline-pallad-diammonium chlorides and bromides, and di-piperidine-pallad-diammonium chloride were prepared by the addition of the bases to an acid solution of palladious chloride or bromide. The composition of the phenyl derivative is $\text{Pd}(\text{NH}_4\text{ClC}_6\text{H}_5)_2$; and the others are analogous, *e.g.* $\text{Pd}(\text{C}_6\text{H}_5\text{NCl})_2$. The names assigned to the latter are, therefore, irrational. To determine the atomic weights of the metal, the author has reduced diphenyl-pallad-diammonium chloride and bromide and ammonium palladium bromide by hydrogen at a red heat. As a mean of the three series of closely checking determinations he gets 107.014 which is much higher than the values adopted by Clarke and Richards (106.36 and 106.5).

The Conversion of Ammonium Thiocyanate into Thiourea and of Thiourea into Thiocyanate. BY JOHN WADDELL. *J. Phys. Chem.*, **2**, 525-535.—The author shows that these two reactions reach the same state of equilibrium, the mixture then consisting of 21.2 per cent. of thiourea at 152°-153° and 20.9 per cent. at 160°-161°; and he finds that the velocity of each of them

corresponds as closely as the rather large experimental errors permit, with the requirements of the mass-action law for a reversible monomolecular reaction. The rate of the reactions is about twice as great at 160° as it is at 152°.

Pressure-temperature Diagrams for Binary Systems. BY WILDER D. BANCROFT. *J. Phys. Chem.*, 3, 1-11.

Reversible Reactions. BY JOHN WADDELL. *J. Phys. Chem.*, 3, 41-45.—The author shows, as has been previously done in detail by Ostwald (*Lehrbuch*, II, 2, 251, 257), that the velocity of a reversible first order reaction can be expressed by the equation $\frac{dx}{dt} = (k_1 + k_2)(\xi - x)$, in which k_1 and k_2 are the velocity constants of the opposing reactions and ξ is the value of x after equilibrium is reached; but that the corresponding simple expression, $\frac{dx}{dt} = (\xi - x)^2$, is not applicable to reversible second order reactions. An omission made by Ostwald in deriving the formula that does hold true in the latter case is pointed out.

Demonstration of the Phase Rule. BY PAUL SAUREL. *J. Phys. Chem.*, 3, 69-71; 137-143.

Dissociation Studies, I. BY WILDER D. BANCROFT. *J. Phys. Chem.*, 3, 72-94.—A graphical discussion of the equilibrium of two component systems.

The Electromotive Forces of Concentration Cells. BY J. E. TREVOR. *J. Phys. Chem.*, 3, 95-105.—The author shows the effect of the heat of dilution (which is ordinarily neglected) on the general equations expressing the relation between electromotive force, concentration, and temperature.

Correction. BY WILDER D. BANCROFT. *J. Phys. Chem.*, 3, 107.—This refers to an error in the calculation of the electromotive force between amalgams in an article by Cady (*J. Phys. Chem.*, 2, 554).

The Composition of Mixed Vapors, I. BY HECTOR R. CARVETH. *J. Phys. Chem.*, 3, 193-213.

On Maxwell's Theorem. BY PAUL SAUREL. *J. Phys. Chem.*, 3, 214-216.

Ternary Mixtures, IV. BY WILDER D. BANCROFT. *J. Phys. Chem.*, 3, 217-231.

Solid Solutions. BY HAMILTON P. CADY. *J. Phys. Chem.*, 3, 127-136.—The author states that naphthalene forms two series

of solid solutions both with monochloracetic acid and with glycolic acid, but hardly any evidence is presented to show that the supposed solid solutions are not simple mixtures of the two separate solid phases.

The Equilibrium of Stereoisomers, III. BY WILDER D. BANCROFT. *J. Phys. Chem.*, 3, 144-155.

On the Molecular Weight of Sulphur in Carbon Bisulphide Solutions. BY H. T. BARNES. *J. Phys. Chem.*, 3, 156-159.—The author calculates a value for the molecular weight from the density (*sic*) of the solutions.

Freezing-point in Ternary Mixtures. BY JOHN WADDELL. *J. Phys. Chem.*, 3, 160-164.

Electrolytic Dissociation and Toxic Effect. BY J. F. CLARK. *J. Phys. Chem.*, 3, 263-316; *Botan. Gaz.*, 28, 289.—The author has determined the minimum concentration of a number of chemical substances that suffices (1) to retard or make irregular the mycelial development and prevent the fruiting of the spores of five different forms of mold, (2) to inhibit entirely their development, and (3) to kill them. The second of these effects is most accurately determinable and is the one mainly discussed. The results in the following table show the number of mols of each substance required to produce an inhibiting effect equal to that of one mol of mercuric chloride when dissolved in the same quantity of water, namely, 7300 liters.

| | | | |
|----------------------|------|---------------------|--------|
| Potassium bichromate | 1.1 | Trichloracetic acid | 321. |
| Silver nitrate | 1.3 | Hydrogen peroxide | 375. |
| Potassium chromate | 1.4 | Ferrous sulphate | 411. |
| Formaldehyde | 5. | Copper sulphate | 468. |
| Hydrocyanic acid | 11. | Copper nitrate | 479. |
| Cadmium nitrate | 22. | Nitric acid | 503. |
| Potassium cyanide | 91. | Potassium hydroxide | 593. |
| Nickel sulphate | 120. | Sodium salicylate | 650. |
| Ammonium hydroxide | 182. | Sulphuric acid | 732. |
| Cobaltous sulphate | 206. | Hydrochloric acid | 821. |
| Monochloracetic acid | 207. | Zinc sulphate | 2150. |
| Dichloracetic acid | 229. | Potassium iodide | 8775. |
| Acetic acid | 296. | Ethyl alcohol | 13164. |

Various other neutral salts were also partially investigated; namely, potassium chloride, bromide, nitrate, and sulphate, and the potassium salts of the three chloracetic acids. All of these salts were only very slightly toxic, having from $\frac{1}{11}$ to less than $\frac{1}{32}$ of the effect of hydrochloric acid. A consideration of the data from a theoretical standpoint leads the author to conclude that

the hypothesis that "the ionized part of a dissolved substance and that only is chemically active" is in disagreement with his own physiological results and also those of others. The main reason for this conclusion is that the partially dissociated acids like acetic and the chloroacetic acids have nevertheless a much more powerful toxic effect than hydrochloric acid and than their neutral salts which contain the same ions in much larger quantity. Without wishing to defend the almost obviously untenable assumption that undissociated molecules never enter into chemical reactions, the reviewer would point out that one important fact has been generally overlooked in the interpretation of the physiological results with reference to the dissociation theory; and that is the well-known *catalytic* effect of hydrogen ions. Thus it is by no means justifiable to assume that because the NO_3 ion has no appreciable toxic influence in a potassium nitrate solution, that the same is true of it in a nitric acid solution where hydrogen ions are simultaneously present. On the contrary, the fact that nitric is more toxic than hydrochloric acid would seem to be due more probably to the oxidizing effect of the NO_3 ion in *acid* solution than to the undissociated HNO_3 molecules.

Some Boiling-point Curves. BY J. K. HAYWOOD. *J. Phys. Chem.*, 3, 317-327.—The author has determined the boiling-points at nearly constant pressure of alcohol-water, alcohol-ether, alcohol-carbontetrachloride, chloroform-carbontetrachloride, chloroform-methylalcohol, acetone-water, acetone-methylalcohol, acetone-ether, and acetone-carbontetrachloride mixtures. The results are presented graphically as well as in a tabular form.

Some Boiling-point Curves, II. BY J. K. HAYWOOD. *J. Am. Chem. Soc.*, 21, 994-1001.—In this paper the boiling-points of mixtures of benzene with chloroform, with carbon tetrachloride, with ether, with acetone, and with methyl alcohol, and of methyl alcohol with ethyl alcohol, with carbon tetrachloride, and with ether are given, and the corresponding boiling-point curves are shown. Of these curves those for benzene with methyl and ethyl alcohols, and for methyl alcohol with carbon tetrachloride, alone show the existence of a minimum boiling-point. No very definite conclusions are drawn from the results.

The Deliquescence of Potassium Nitrate, Sodium Nitrate, and Ammonium Nitrate. BY F. L. KORTRIGHT. *J. Phys. Chem.*, 3, 328-333.—These three salts were placed on watch-glasses in desiccators over mixtures of sulphuric acid and water of known concentrations and vapor-pressures, gradually increasing the amount of water in the acid until the salt gained in

weight. The minimum pressures of water vapor causing deliquescence were thus found to be at 20° between 8.5 and 10.8 mm. for ammonium nitrate, between 12.3 and 13.5 mm. for sodium nitrate, and between 15.5 and 16.5 mm. for potassium nitrate. The vapor-pressure of pure water at 20° is 17.4 mm. The author has determined by extrapolation from existing data the vapor-pressures of saturated solutions of the salts and find these in agreement with the deliquescence pressures, as theory requires.

On the Stability of Equilibrium of a One Component System.

BY PAUL SAUREL. *J. Phys. Chem.*, 3, 334-336.

Notes on the Energy Theory. BY J. E. TREVOR. *J. Phys. Chem.*, 3, 339-348.—The author differentiates the energy-changes that may take place in any system into (mechanical) work terms and into what he calls work-equivalent terms; the former are the product of forces into changes of space (distance, surface, or volume), and the latter, including all other energy-changes, are the product of potentials into changes of "quantity-coordinates."

Minimum Boiling-points and Vapor Compositions. BY J. H. PETTIT. *J. Phys. Chem.*, 3, 349-363.—The author has determined the boiling-points of various mixtures of methyl alcohol and ether, methyl alcohol and chloroform, and methyl alcohol and acetone, and of the four pure substances. The last two mixtures have a minimum boiling-point when the concentration of the methyl alcohol is about ten per cent. The purpose of the work was to test the "theorem" of Bancroft that all miscible liquids whose temperature-vapor pressure curves intersect form mixtures with a maximum or minimum boiling-point at some concentration. Besides his own experiments the author takes into consideration those of others, and concludes that the theorem is fully supported by the facts.

Dissociation Pressure before H. Sainte-Claire Deville. BY P. DUHEM. *J. Phys. Chem.*, 3, 364-378.—The author points out that in 1837, a French scientist, Georges Aimé, published a thesis in which he clearly stated the principle of constant dissociation-pressure, and communicated experiments confirming it, on calcium carbonate and hydrochloric acid, and sodium carbonate and various organic acids, in which he showed that these reactions ceased when the partial pressure of the carbon dioxide reached a definite value which was independent of the amounts of carbonate and acid brought together, of the capacity of the closed vessel, and of the presence or absence of air in the vessel.

On the Paraanisaldoximes. BY H. R. CARVETH. *J. Phys. Chem.*, 3, 437-451.—This investigation is along the lines of previous ones from the same laboratory. (See *this Rev.*, 4, 97.)

On the Relation between Pressure and Evaporation. BY EDWIN H. HALL. *J. Phys. Chem.*, 3, 452-456.—The author states that Nernst in deriving the equation for isothermal chemical equilibrium neglects the work done on the condensed substances that may be involved; and by making this correction the author derives a relation between temperature, total pressure, and vapor-density in the case of a pure solid or liquid. The reviewer would point out, however, that if the pressure is so high as to make the mentioned correction appreciable, the deviations from the simple gas laws would be so also; and the derived relation would have a different form.

Thermal Coefficients. BY J. E. TREVOR. *J. Phys. Chem.*, 3, 523-547.—A complete mathematical treatment of the fundamental relations between pressure, volume, temperature, entropy, energy, free energy, the heat function, and the thermodynamical potential.

Hydrates in Solution. BY WILDER D. BANCROFT. *J. Phys. Chem.*, 3, 551-554.—Nernst showed that, in the case of a hydrate of the formula, $A \cdot nH_2O$, dissociating into its components A and n molecules H_2O , the mass-action law requires, since for not too concentrated solutions the concentration of the water is constant, that the concentrations of the hydrate and anhydrous substance be proportional to each other, or that the proportion of hydrated substance be independent of the concentration. This last statement, which is obviously to be understood to mean that the ratio of hydrate to the sum of hydrate and anhydrous substance is constant, is misinterpreted by the author so as to signify that the ratio of hydrate to the total amount of substance present, no matter what its molecular condition may be, is constant; and it is correctly shown by him that in this sense the statement is not applicable to hydrated salts which at the same time undergo electrolytic dissociation; for in that case the amount of undissociated anhydrous salt is, it is well-known, not proportional to the total amount of salt present. In regard to the equilibrium of hydrated salts in solution, the reviewer would add that it is just as probable that the ions are hydrated as that the undissociated molecules are.

The Specific Heat of Metals at Low Temperatures. BY C. C. TROWBRIDGE. *Science*, 8, 6-11. The author has determined by the method of mixtures the mean specific heat of copper, iron, and aluminum between $+13$ and -181.4° , the temper-

ature of boiling oxygen obtained from liquid air, and finds the values 0.0868, 0.0914, and 0.1833 respectively, which are less than the mean specific heats between 23° and 100° by 7.6, 21.3, and 15.7 per cent., respectively.

H. M. GOODWIN, REVIEWER.

Note on the Coefficient of Expansion of Ice. BY EDWARD L. NICHOLS. *Phys. Rev.*, **8**, 184-186.—The author gives the result of a direct determination of the coefficient of expansion of artificial ice cut in the form of a bar 45 cm. long, 12 cm. wide, and 5 cm. thick. The measurements were made on a dividing-engine, during a period when the temperature varied from -3° to -17°. The value 0.000540 ± 0.000020 was obtained for a mean temperature interval of -8° to -12°. This value agrees well with that obtained by a similar method by Struve (0.000530), and that obtained by Plücker and Geissler (0.000528) by the dilatometer method. The results of Brunner and of Marchand are much lower: the differences may be due to the specimen of ice employed.

The Electrical Conductivity of Non-Aqueous Solutions. BY AZARIAH T. LINCOLN. *J. Phys. Chem.*, **3**, 456-494.—This article forms a continuation of a paper by Kahlenberg and the author on the Dissociating Power of Solvents (*this Rev.*, **5**, 47). Additional qualitative determinations of the solubility of eighteen inorganic salts, mostly chlorides, were first made in twenty-nine organic solvents. Quantitative conductivity measurements were then made of solutions of ferric chloride in various organic solvents, as well as of several solutions of bismuth, antimony, aluminum chloride, and silver nitrate. The work and conclusions of other investigators are discussed and recapitulated in connection with the results obtained and the general conclusion is drawn that the dissociation theory and all other proposed theories fail completely to explain the results thus far obtained for non-aqueous conducting solutions. No rigid classification of solvents with reference to the conductivity of their solutions is made, although in general the Thomson-Nernst dielectric constant criterion is found to hold true.

The Influence of Substituents on the Electrical Conductivity of Benzoic Acid. BY ALFRED TINGLE. *J. Am. Chem. Soc.*, **21**, 792-804.—The electrical conductivity of the alkali salts of the ortho and para halogen-substituted benzoic acids was determined at 25° C. for dilutions of 64 and 128 liters. The difference between the molecular conductivity of the same salts of two metals was found to vary widely with the acid with which the metals were in combination. The results are, however, consid-

ered only preliminary. If further measurements are to embrace but two dilutions, it would be much better to choose 37 or 64 liters and 1024 liters for the reasons pointed out by Bredig, and then compare the extrapolated μ_{∞} values.

Differences of Potential between Metals and Non-Aqueous Solutions of Their Salts. BY LOUIS KAHLENBERG. *J. Phys. Chem.*, 3, 379-404.—The potential differences between silver and decinormal solutions of silver nitrate in various organic solvents were measured against a normal electrode by the usual compensation method with capillary electrometer. Also those between a number of other metals and decinormal solutions of such of their salts as were sufficiently soluble in organic solvents were determined. In all eighty-nine combinations including some twenty or more solvents were investigated. The conclusion drawn by Jones from a similar investigation with aqueous, methyl and ethyl alcoholic and acetone solutions, namely, that the electrolytic solution tension of a metal is a function of the solvent, is further verified by the more extensive data thus obtained. From the values of the potential difference of different metals in the various solvents, it is probable that the order of the metals in the voltaic series also varies with the solvent. Values of P , the electrolytic solution pressure, could not be computed for lack of data on the dissociation of the dissolved salts. On account of the fact that the electrolytic solution pressure varies with the solvent or mixture of solvents, the author seems to question the definiteness and value of the concept of the quantity as such. This seems to the reviewer unnecessary, for the same change of numerical value is observed in the solubility of all substances in different solvents; thus, ordinary solubility (that is, the solution pressure of the solute) and electrolytic solution pressure of a metal, are analogous quantities and are completely determined for a given substance by temperature, pressure, and the nature of the solvent.

The Specific Heat of Solutions which Are Not Electrolytes. BY WM. FRANCIS MAGIE. *Phys. Rev.*, 9, 65-85.—The author deduces (under certain assumptions), the relation that the specific heats of solvent and solute are constant at all concentrations. In somewhat different form the same result has also been recently published by Schiller. To test this relation, the specific heat of various solutions, cane-sugar, dextrose, mannite, and urea in water, as well as of solutions in alcohol and aniline was determined by a modification of Pfaundler's method. The relation was found to be verified in many cases. Alcohol, either as solute or solvent, formed an exception. The data are as yet insufficient to warrant the general conclusion that the molecular heat of a dissolved substance is independent of the solvent.

On the Spectra of Krypton. BY C. RUNGE. *Astro-phys. J.*, 10, 73.—The krypton was prepared as described by Ramsay and Travers from liquid air, and contained some argon. The gas emitted two spectra, one with Leyden jar or spark gap in the secondary circuit, the other without Leyden jar and spark gap, as is the case with argon. The lines due to krypton were measured, argon lines being eliminated by comparison with a photograph of an argon spectrum. It is interesting to note that the author identifies the lines of Ramsay's metargon with the carbon lines, as was first pointed out by Schuster. He suggests that they may be due to a compound of argon and carbon which is not decomposed by sparking in an atmosphere of oxygen.

INORGANIC CHEMISTRY.

HENRY FAY, REVIEWER.

A Contribution to Our Knowledge of Dicarboxyl Cuprous Chloride. BY WILLIAM APP JONES. *Am. Chem. J.*, 22, 287-311.—Dicarboxyl cuprous chloride, prepared by passing carbon monoxide into cuprous chloride moistened with hydrochloric acid, was obtained in white crystalline plates which decomposed rapidly on drying. The compound was analyzed by decomposing it by heat, measuring the carbon monoxide liberated, and weighing the water; also, by determining the increase in weight of cuprous chloride when carbon monoxide is passed over it. The analyses show that the compound has the composition represented by the formula $\text{Cu}_2\text{Cl}_2 \cdot 2\text{CO} \cdot 4\text{H}_2\text{O}$. The compound is decomposed by diminished pressure and by increase of temperature. The gas given off does not show any marked increase in chemical activity. Oxygen and chlorine cause only very slight decomposition, and hydrogen and nitrogen are without action. The general properties of dicarboxyl cuprous chloride are similar to those of other inorganic compounds containing carbon monoxide. It is to be considered as a true chemical compound.

The Occlusion of Hydrogen by Metallic Cobalt and Other Metals. BY GREGORY PAUL BAXTER. *Am. Chem. J.*, 22, 351-364.—The amounts of hydrogen occluded by metallic cobalt, nickel, copper, and silver were determined by igniting the reduced metals in a current of air and weighing the water formed. The volume of occluded hydrogen depends upon the amount of surface presented, the purity of the metal, and the temperature of reduction. With cobalt the metal in the form of ingots occludes less hydrogen than that deposited in the form of foil by the electric current. The fine powder obtained from the reduction of the oxide occludes hydrogen in amounts varying with the purity

and the method of preparation. Perfectly pure oxide reduced in hydrogen at 400° – 500° occludes about half as much gas as the impure oxide, containing small amounts of alkali and silica, the increased amounts in the latter case being due to the more porous material. The property of spontaneous oxidation was shown to be due not to the amount of hydrogen occluded but to the large amount of surface exposed to the air. Occlusion proceeds slowly at ordinary temperatures and is dependent upon the time of contact of the metal with hydrogen. Nickel is subject to the same influences as cobalt, the pure metal occluding only traces of hydrogen. The extent of occlusion varies with the fusion-points of the metals,—the higher the melting-point the greater is the occlusion. Silver and copper, whose melting-points are close to the temperature of reduction, consequently occlude smaller amounts of gas, because the sintering together of the metal is greater, thus diminishing the extent of the surface. Pure silver and copper occlude only small amounts of hydrogen.

The Electrolysis of Metallic Phosphate Solutions. BY HARVEY M. FERNBERGER AND EDGAR F. SMITH. *J. Am. Chem. Soc.*, **21**, 1001–1007.—The current density, voltage, dilution, and temperature are given for the quantitative separation of copper from iron, aluminum, chromium, cobalt, nickel, zinc, and manganese using solutions of their phosphates. Mercury and nickel may also be precipitated quantitatively from phosphate solutions.

Observations upon Tungsten. BY EDGAR F. SMITH. **I. The Action of Sulphur Monochloride upon Tungsten Trioxide.** BY HERMANN FLECK. **II. Tungsten Alkyls.** BY E. A. BARNETT. **III. Tungsten Alkyls.** BY CLARENCE HALL. **IV. Esters of Tungstic Acid.** BY CLAUDE DUGAN. **V. The Atomic Mass of Tungsten.** BY WILLETT L. HARDIN. *J. Am. Chem. Soc.*, **21**, 1007–1027.—

I. By heating finely divided wolframite, scheelite, tungsten trioxide, or tungsten dioxide, with sulphur monochloride to 145° tungsten oxytetrachloride, WOCl_4 , was formed in scarlet-red crystals which decomposed readily in the air. This compound is soluble in carbon disulphide and sulphur monochloride, and may be purified by sublimation. It has been shown that there is a crystalline form of tungsten trioxide which is insoluble in sulphur monochloride at 145° . Pure sulphur monochloride does not attack metallic tungsten.

II. It was impossible to obtain tungsten alkyls either by heating metallic tungsten with methyl iodide, or by the action of mercury ethide upon tungsten hexachloride.

III. An unsuccessful attempt was made to prepare tungsten alkyls from zinc methide and tungsten hexachloride.

IV. Esters could not be obtained by treating tungsten oxytetrachloride with alcohols. The products indicated that the reaction was incomplete.

V. The author has shown that the usual methods of determining the atomic weight of tungsten are not trustworthy. Tungsten trioxide prepared from tungsten oxychloride cannot be obtained pure and its reduction to metal in a current of hydrogen consequently gives varying results for the atomic weight. The metal does not occlude hydrogen to any extent. By oxidation of the metal to tungsten trioxide results were obtained which varied from 184.1 to 184.8 because of the volatility of the oxide. Analyses of tungsten oxychloride, and of barium metatungstate, were likewise untrustworthy. The most probable value the author considers to be 184, until more accurate methods can be devised.

Note on the Color of Chlorine Solutions. BY E. H. SARLES.
J. Am. Chem. Soc., 21, 1038.—A preliminary note.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

ANALYTICAL CHEMISTRY.

ULTIMATE ANALYSIS.

H. P. TALBOT, REVIEWER.

The Determination of Nickel in Nickel-Steel. BY GEO. WM. SARGENT. *J. Am. Chem. Soc.*, **21**, 854-857.—The steel is dissolved in hydrochloric acid, the iron oxidized by nitric acid (the excess of which is removed by evaporation to dryness), and the hydrochloric acid solution of the residue treated with ether, which has previously been shaken with strong hydrochloric acid. A single treatment was found to suffice. The aqueous solution containing the nickel is treated with ammonia and the acidified filtrate with sulphuretted hydrogen to remove any copper. The filtrate is concentrated, ammonia is added in slight excess, then measured quantities of solutions of silver nitrate and potassium iodide, after which a standard potassium cyanide solution is added until the opalescence due to silver iodide just disappears. Compare the method of Chase (Blair: *The Chemical Analysis of Iron, Appendix to Third Edition*); and Campell and Andrews: *J. Am. Chem. Soc.*, **17**, 125.

The Quantitative Estimation of Boric Acid in Tourmaline. BY GEORGE W. SARGENT. *J. Am. Chem. Soc.*, **21**, 858-888.—The results of the experiments described in this paper are summarized at its close, and cannot well be further condensed. The paper includes a historical résumé of earlier work in this field, and a bibliography.

Electrolytic Determinations and Separations. BY LILY G. KOLLOCK. *J. Am. Chem. Soc.*, **21**, 911-928.—The methods for

the electrolytic determination or separation of a considerable number of metals have been subjected to examination with a view of defining with exactness the conditions essential for success, especially with respect to amperage, voltage, and current density. Reference to the original article is necessary for the detailed results.

The Precipitation of Copper by Zinc. BY JOHN C. SHENGLE AND EDGAR F. SMITH. *J. Am. Chem. Soc.*, **21**, 932-933.—The authors find that copper precipitated from its solutions by means of zinc always contains small, variable quantities of the latter metal.

Note: Analysis of Zinc for Cadmium and Lead. BY P. A. MACKAY. *J. Am. Chem. Soc.*, **21**, 940-941.—The greater portion of the zinc is dissolved in hydrochloric acid, leaving the lead and cadmium deposited upon the residual zinc. After solution in nitric acid the lead is removed as sulphate, the cadmium thrown down as sulphide, dissolved in hydrochloric acid, a known solution of zinc chloride is added, and the whole titrated with potassium ferrocyanide.

Notes on the Determination of Sulphur in Pig-Iron. BY M. J. MOORE. *J. Am. Chem. Soc.*, **21**, 972-975.—The author finds marked differences in the results obtained by volumetric determinations of sulphur made upon shot samples and sand samples of pig-iron taken from the same mixer. The results obtained from the shot samples are low as compared with the gravimetric determinations.

Note: The Determination of Chromium in Steel. BY R. W. MAHON. *J. Am. Chem. Soc.*, **21**, 1057-1060.—The author states the results of experiments made to determine exact conditions as to volume, quantity of reagents, etc., which are best for use in McKenna's method for the estimation of chromium (*Proc. Eng. Soc. Western Penn.*, **11**, No. 6).

The Direct Determination of Available Phosphoric Acid. BY F. P. VEITCH. *J. Am. Chem. Soc.*, **21**, 1090-1094.—The author shows that the discrepancies in the method of Ross (*U. S. Dept. Agr., Div. Chem., Bull.* **38**, 17), as compared with the official method, arise from the failure to take account of the phosphoric acid in the washings of the citrate-insoluble material. He also makes a comparison of the official method with the citrate and molybdate methods, as applied to the combined filtrates containing the citrate-soluble and water-soluble phosphoric acid. The molybdate method yields satisfactory results.

Note upon the Determination of Nitrogen in Fertilizers Containing Nitrates. BY F. P. VEITCH. *J. Am. Chem. Soc.*, **21**, 1094-1095.—The author describes a modification of the Gunning method (*U. S. Dept. Agr., Div. Chem., Bull.* **46**) slightly different from that described by Fields (*this Rev.*, **3**, 32). The fertilizer is treated with the mixture of sulphuric and salicylic acids in the cold.

The Determination of Graphitic Carbon in Cast and Pig Iron. BY ALLEN P. FORD AND I. M. BREGOWSKY. *J. Am. Chem. Soc.*, **21**, 1113-1115.—The use of a platinum Gooch filter instead of a paper filter, and of hydrofluoric acid to remove the silica, is recommended by these authors. They find that graphitic carbon is slowly oxidized by nitric acid of 1.20 sp. gr. on boiling, but is not affected by acid of 1.12 sp. gr.

W. H. WALKER, REVIEWER.

The Iodometric Determination of Gold. BY F. A. GOOCH AND F. H. MORLEY. *Am. J. Sci.*, **158**, 261-266.—In a recent attempt to determine small quantities of gold in solution by allowing auric chloride to react with potassium iodide, and titrating the iodine liberated with sodium thiosulphate, Peterson (*Ztschr. anorg. Chem.*, **19**, 63) found that one-half more thiosulphate is consumed than would be required if the thiosulphate were simply converted to tetrathionate in the usual manner. The authors have studied this reaction and find no evidence of any variation from the usual reaction of sodium thiosulphate and iodine. The reduction of the auric salt and the consequent liberation of iodine is, however, dependent upon the volume of the solution, the mass of iodine present, and the time of action. By using one-thousandth normal solutions the process is made fairly accurate.

On the Volumetric Estimation of Cerium. BY PHILIP E. BROWNING. *Am. J. Sci.*, **158**, 451-459.—The iodometric method of Bunsen (*Ann. Chem. (Liebig)*, **105**, 49) for the determination of cerium is modified in that a glass-stoppered bottle is used in the place of a flask with the neck drawn out and closed by heat. As a further check on the accuracy of the method, the iodine set free by the reaction of cerium dioxide and potassium iodide was distilled from a retort in a stream of carbon dioxide and received in a solution of potassium iodide. The results obtained by both these methods are very satisfactory. An attempt to estimate cerium dioxide by reduction with arsenious acid proved unsatisfactory. The statement by Stolba (*Ztschr. anorg. Chem.*, **19**, 194) that cerium could be estimated in the same manner as calcium oxalate, by oxidizing the precipitated cerium oxalate with standard potassium permanganate is proved correct.

On the Estimation of Thallium as the Chromate. By PHILIP E. BROWNING AND GEORGE P. HUTCHINS. *Am. J. Sci.*, 158, 460-462.—The authors have repeated the work of Baubigny (*Chem. News*, 64, 239) on the gravimetric estimation of thallium, and obtained results which confirm his statements. Instead of weighing the thallium chromate precipitate, the thallium may be estimated volumetrically by determining the amount of chromate in the filtrate by means of standard solutions of arsenious acid and iodine, and, by difference, the amount of chromate combined with the thallium. The results compare very favorably with those by the gravimetric method.

PROXIMATE ANALYSIS.

A. G. WOODMAN, REVIEWER.

Directions for Certain Alkaloidal Assays. By H. M. GORDIN AND A. B. PRESCOTT. *Am. J. Pharm.*, 71, 462-473.—This paper is a résumé of the work done by the authors on the extraction of alkaloids and their volumetric estimation as higher periodides. It contains the directions for the general method of alkaloidal extraction and assay, and for the modification of the general method in special cases.

Further Work upon the Estimation of Alkaloids and the Assay of Alkaloidal Drugs. By H. M. GORDIN AND A. B. PRESCOTT. *Am. J. Pharm.*, 71, 514-525.—In this paper the authors present some of the experimental data upon which they have based their methods for alkaloidal assay, discussing the composition and properties of the periodides of emetine and of hydrastine, and giving directions for the assay of hydrastis and the hot extraction of opium. A table is appended showing the comparative merits of the gravimetric and the iodometric methods of assay.

A Simple Alkalimetric Method for the Estimation of Salt-forming Alkaloids with the Aid of Phenolphthalein as Indicator. By H. M. GORDIN. *Pharm. Archives*, 2, 313-318.—The direct alkalimetric estimation of alkaloids is in many cases unsatisfactory, owing to the fact that the end-point is not very sharp. In some alkaloidal salts the acid acts as if wholly free, so that indicators show no end-point at all until the acid used is all neutralized. Often it is necessary to make the titration in a solution colored by non-alkaloidal matter. To obviate these difficulties it is proposed to dissolve the alkaloid in an excess of standard acid, precipitate the alkaloid by some neutral alkaloidal reagent, filter, and determine the free acid in the filtrate. As there is no alkaloid in the filtrate to interfere with the indicator, phenolphthalein can be used with satisfactory results.

For ordinary cases either Mayer's or Wagner's reagent may be used as a precipitant. Berberine and colchicine cannot be estimated by this method.

Modified Assay Process for Fluid Extracts. BY A. B. LYONS. *Pharm. Rev.*, 17, 558-560.—For the extraction of alkaloids from preparations containing much tannin, such as fluid extract of cinchona bark, it is recommended to shake a definite volume of the extract with a dilute alcoholic solution of ferric chloride, made alkaline with ammonia. The mixture is allowed to settle, is then filtered, and an aliquot part of it is evaporated with dilute hydrochloric acid to drive off the greater part of the alcohol; the acid solution is then shaken with ether to remove the fats and waxes. Finally the solution is made alkaline with ammonia, and shaken out with ether, as usual. The results obtained are satisfactory. If desired, a solution of basic lead acetate may be substituted for the ferric chloride.

A Note on the Assay of Opium. BY WILLIAM R. LAMAR. *Am. J. Pharm.*, 72, 36-39.—The author has modified the U. S. P. method for the assay of opium by increasing the amount of alcohol which is added to the aqueous extract of the opium, in this way getting rid of the objectionable matters in solution.

On Acetic Acid as a Substitute for Ethyl Alcohol in Extracting the Active Principles of Some Official Drugs. BY EDWARD R. SQUIBB. *Am. J. Pharm.*, 72, 1-9.—In this paper, which is the third in the series, the author presents the results of further experience in the use of acetic acid as a menstruum, and gives in detail the procedure for the assay of belladonna root.

The Phenylhydrazine Test for Sugar in the Urine. BY I. H. CORIAT. *Boston Medical and Surgical J.*, 141, 518-519.—The author has studied the phenylhydrazine test for sugar with especial reference to the examination of urine, and finds that substances that interfere with Fehling's or Nylander's reagents do not interfere in any way with this test. It is not necessary to remove albumin, and the various sugars can be recognized by their crystalline forms and melting-points. The limit of delicacy of the test is about one part in 10,000.

Lemon Flavoring Extract and Its Substitutes. BY A. S. MITCHELL. *J. Am. Chem. Soc.*, 21, 1132-1137.—The author describes the methods which he has found most satisfactory in the examination of lemon extract. In the absence of sugar the oil of lemon is readily estimated by polarizing the extract in a 200 mm. tube and dividing the result in degrees by 3.4. The oil may also be separated by the centrifugal machine and meas-

ured in an ordinary Babcock skim-milk bottle. Tests for various minor adulterants are described and a table is given showing the results of examination of several characteristic extracts.

On Rapid Methods for the Estimation of the Weight of Suspended Matters in Turbid Waters. BY CHARLES L. PARMELEE AND JOSEPH W. ELLMS. *Tech. Quart.*, 12, 145-164.—Many of the surface waters of the central and western parts of the United States contain such quantities of suspended matters, mainly clay, that this question becomes one of considerable importance. The standard method of estimation of the suspended material is a gravimetric one. In order to secure a more rapid method, comparative trials of the following methods were made on Ohio river water: (1) The water was compared with standards containing known amounts of suspended matter; (2) the amount of light which is absorbed in its passage through the water was measured directly; (3) determinations were made of the vanishing-depth of a bright wire; (4) a method was employed based on the use of the diaphanometer. This instrument consists essentially of a tube with a transparent diaphragm at the lower end. Light is reflected up through the tube, water being admitted until an image painted on the diaphragm just disappears. The results of a number of experiments show that by the use of standard clay solutions reasonably close estimations can be made when the suspended matters amount to less than 25 parts per million. When the water contains more than this quantity of suspended matter, the diaphanometer method gives results which agree fairly well with the gravimetric estimations. Greater variations in the character of the suspended particles is found to increase the error in the use of any of the rapid methods.

Silica Standards for the Determination of Turbidity in Water. BY GEORGE C. WHIPPLE AND DANIEL D. JACKSON. *Tech. Quart.*, 12, 283-287.—The authors have substituted silica from diatomaceous earth for the kaolin previously used, and get a uniformity of results which, taken in connection with its ease of use, lead them to recommend it.

F. H. THORP, REVIEWER.

Notes on the Analysis of Dynamite and Gelatine-Dynamite. BY F. W. SMITH. *J. Am. Chem. Soc.*, 21, 425-431.—Typical analyses of a dynamite and of a gelatine-dynamite, with notes and precautions, are given in detail. Also various notes on the use of the nitrometer, its standardizing by the use of potassium nitrate, testing for leaky stop-cocks, etc., are communicated.

Tannin Determination—Estimation of Reds without the Use of Filter-paper. BY J. N. HURTY. *Leather Manufacturer*, 10,33.—Two methods were tried. First, simple filtration through ignited asbestos in a Gooch crucible was used. Second, the material was subjected to treatment in a centrifugal machine running 2000 revolutions per minute, for 30 minutes, to separate the reds in the extract. With chestnut-oak extract, an addition of barium sulphate is necessary, to cause complete precipitation of the reds. Test analyses of quebracho, chestnut-oak extract, and spent tan (oak bark) are given, and compared with the results obtained by filtering through paper. It is concluded that neither asbestos nor barium sulphate absorbs tannin.

A. H. GILL, REVIEWER.

The Determination of Carbon Monoxide, Methane, and Hydrogen by Combustion. BY L. M. DENNIS AND C. G. HOPKINS. *J. Am. Chem. Soc.*, 21, 398-410.—The apparatus employed is a modified Winkler grisometer, with an adjustable leveling bulb, using mercury as the confining liquid. The gas to be determined is introduced into the grisometer, the spiral brought to a suitable temperature, and a quantity of oxygen more than sufficient to burn it passed in at a rate not exceeding 20 cc. per minute. The combustion takes place quietly and without the appearance of a flame. The results upon the single gases were correct within 0.1 per cent., and upon mixtures within 0.1-0.2 per cent. The apparatus is simple and easy of construction and manipulation, and will be welcomed by all having occasion to make gas analyses.

The Preservation of Hübl's Reagent. BY R. BOLLING. *Am. Chem. J.*, 22, 213-214.—The results indicate that the alteration in the solution is rapid, and is retarded but slightly by the use of absolute alcohol or by the exclusion of air and light.

J. F. NORRIS, REVIEWER.

The Valuation of Saccharin. BY E. EMMET REID. *Am. Chem. J.*, 21, 461-471.—The amount of saccharin in a commercial sample, which always contains *p*-sulphaminebenzoic acid, can be determined by saponifying the benzoic sulphinide and estimating the ammonia formed. The saponification is effected by heating at 100° for several hours with 71 per cent. sulphuric acid, or by boiling with dilute hydrochloric acid under definite conditions. The latter method gives more trustworthy results, as sulphuric acid causes a slight decomposition of the sulphamine acid. The methods of analysis were applied with excellent results to a number of samples of commercial saccharine and to mixtures of known composition. Boiling sodium hydroxide

solution readily converts benzoic sulphinide into the sodium salt of *o*-sulphaminebenzoic acid, but does not break this acid down. This fact renders a determination of saccharine in the presence of ammonium salts possible. The nitrogen in *p*-sulphaminebenzoic acid was determined by heating the acid with concentrated sulphuric acid at 230° – 260° , making alkaline, and titrating the ammonia set free.

Hydrastine Hexaiodide, and the Assay of Hydrastis Canadensis, by Means of Standard Iodine for Hydrastine and of Standard Potassium Iodide for Berberine. BY H. M. GORDIN AND A. B. PRESCOTT. *J. Am. Chem. Soc.*, **21**, 732–741; *Am. J. Pharm.*, **71**, 257–267.—When a dilute solution of hydrastine is added to a large excess of a solution of iodine in potassium iodide a hexaiodide is precipitated. By determining the excess of iodine the amount of the alkaloid can be estimated. If iodine is added to a solution of hydrastine, a triiodide is formed. Berberine is quantitatively precipitated by potassium iodide. A detailed account of the assay of *hydrastis canadensis* is given.

INDUSTRIAL CHEMISTRY.

F. H. THORP, REVIEWER.

Action of a Hard Water on Certain Metals. BY JAS. LEWIS HOWE AND J. L. MORRISON. *J. Am. Chem. Soc.*, **21**, 422–425.—The experiments of the authors show that hard water containing an excess of carbon dioxide and considerable magnesia, acts readily upon zinc, corrodes brass, and attacks lead; but that aluminum is not attacked, and in the absence of air iron is only slightly dissolved.

Glass-making in the United States. BY ROBERT LINTON. *Eng. Min. J.*, **68**, 454.—Having described briefly the methods and materials used in glass-making, the writer gives calculations of the cost of plate, window, flint, and bottle glass-making, comparing with these the cost of glass-making in Germany. A noticeable variation between the costs of fuel and labor in the two countries is shown. An interesting review of the progress of the industry in this country is included, and it appears that machines are being rapidly introduced for making fruit-jars, lamp chimneys, and similar articles, thus replacing the costly manual labor. Continuous tank furnaces are displacing the old pot furnaces, and automatic weighing and mixing machines are replacing the often careless "boss mixer." For fuel, gas is almost universally used; natural gas still plays an important though steadily diminishing part, while producer gas, although more troublesome to use than natural gas, has steadily replaced

coal. Oil is mainly employed for secondary furnaces, as reheating and flattening ovens, etc. Several analyses of materials and different varieties of glass are given.

Manufacture of Sodium Nitrite. BY M. A. DARBON. *Am. Gas Light J.*, 81, 575.—Purified sodium nitrate is melted in large cast-iron vessels, thus evaporating hygroscopic water and decomposing iodates, etc. The nitrate fuses at 310°C . and the temperature is raised to 400° – 420°C . before adding any lead. The lead must be pure and free from other metals, especially antimony. It is made into thin sheets, and 280 parts of lead are used for each 100 parts of sodium nitrate. The lead is gradually added while stirring constantly. The charge must not be overheated, or the vessel will be rapidly destroyed. The temperature is kept down by adding cold nitrate, if necessary, or by drawing the fire. After all lead is added, stirring is continued for some time, and then the charge is ladled out into cold water, being poured in a fine stream while stirring constantly. By the decomposition of the sodium nitrate some caustic soda is formed, which dissolves some of the lead oxide formed. The whole solution is therefore neutralized with nitric acid, which precipitates lead hydroxide and forms some sodium nitrate. Lead nitrate or sulphuric acid may also be used for this neutralizing, but the latter forms sodium sulphate, which separates as anhydrous salt in the concentration vessels. The aqueous solution thus contains nitrite, unchanged nitrate, caustic soda holding lead oxide in solution, and all soluble impurities. The insoluble residue is made up of metallic lead, litharge, and lead peroxide. The solution is diluted to 6° – 8°Bé . before neutralizing with nitric acid, and this is added as long as a precipitate continues to fall. Sodium nitrite has a neutral reaction, and the commercial product should not show an alkaline reaction. The solution is decanted and evaporated in iron pans to 42° – 45°Bé , measured in the hot liquor, and then cooled and allowed to crystallize. The pure crystals are recrystallized, and the pure crystals “centrifiged,” washed, dried at 50°C ., and packed. A method of titrating nitrite solution with standardized permanganate solution is explained.

A. G. WOODMAN, REVIEWER.

The Comparative Value of Certain Reagents for Removing Lime and Magnesia from Natural Waters for Industrial Uses.

BY MARTIN L. GRIFFIN. *J. Am. Chem. Soc.*, 21, 665–678.—The reagents used as coagulants were sodium hydroxide, sodium phosphate, sodium fluoride, sodium aluminate, and barium hydroxide. These were tried on simple calcium and magnesium solutions and also on natural waters. While no one reagent

was found to be best in all cases, sodium hydroxide gave the best results with the majority of waters. Sodium fluoride is to be preferred for waters containing calcium sulphate and chloride, while barium hydroxide is most serviceable in the treatment of acid mine waters.

The Engineering Chemistry of Boiler Waters. BY HENRY LEFFMANN. *Am. Gas Light J.*, 69, 416-418.—This paper is a discussion of the causes of corrosion and scale-forming in boilers and of various methods for preventing this.

A. H. GILL, REVIEWER.

Chemical Analysis of Wyoming Petroleum. BY E. E. SLOSSON. *School of Mines, Univ. Wyo., Bull.* 3, 26-31.—The three petroleum examined are all very heavy, having a specific gravity of 0.915-0.935 and a flash of 123°-134° C. No considerable quantity of oil will volatilize under 270° C., at which temperature it cracks, giving light and heavy products. On redistillation the oils break up still further into undesirable mixtures. The crude petroleum is a better lubricant than any products obtained from it. The three samples contained 0.3, 0.1 per cent. and no sulphur, respectively.

E. H. RICHARDS, REVIEWER.

The Quality of the Boiler Water Supply of a Portion of Northern Illinois. BY JAMES A. CARNEY. *Trans. Am. Inst. Min. Eng.*, 27, 130-139.—This paper is a contribution to the solution of the problem of the best feed water for locomotive boilers. Thirty-eight samples were taken from the possible sources of supply along the C. B. & Q. R. R. between Chicago and Burlington, a distance of about 200 miles. The average of the three classes of water is given in grains per U. S. gallon. The total solids in the surface waters were 16.62, in the shallow wells 37.99, and in the deep waters 72.11 grains, while the incrusting solids were 14.88, 35.09, and 23.30, respectively, for the three classes of waters. Surface waters are recommended wherever practicable, as containing not only less incrusting solids but less sodium salts, which, if present in any quantity, give rise to "foaming."

BIOLOGICAL CHEMISTRY.

A. G. WOODMAN, REVIEWER.

Asterionella: Its Biology, Its Chemistry, and Its Effect on Water Supplies. BY GEORGE C. WHIPPLE AND D. D. JACKSON. *J. N. E. Water Works Assoc.*, 14, 1-23.—Having been enabled to collect *Asterionella* quite pure and in considerable

quantities, the authors have made a complete analysis of it. The most striking feature of the analytical results is the high percentage of mineral matter, amounting to 57.52 per cent. of the dry weight of the organism; 49.48 per cent. of the dry weight is silica, which forms the cell wall. The authors have calculated the amount of certain materials, such as silica and manganese, which a water must contain in order to admit of the growth of the organism, basing their calculation on the weight of an *Asterionella* cell. In order to check the growth of the organism, it is recommended to limit the supply of available food material, especially of silica, manganese, iron, and nitrates.

The Amount of Humus in Soils and the Percentage of Nitrogen in the Humus, as Affected by Applications of Air-slaked Lime and Certain Other Substances. BY H. J. WHEELER, C. L. SARGENT, AND B. L. HARTWELL. *J. Am. Chem. Soc.*, 21, 1032-1037.—The authors have carried out experiments on the effect of various fertilizing materials on the amount of humus in soils. They find that, without exception, the addition of air-slaked lime or gypsum lowers the total amount of humus, but that the percentage of nitrogen in the humus is increased. When sodium nitrate was applied without the use of lime, the percentage of humus and of nitrogen reached a maximum.

A Contribution to the Chemistry of Butter-fat. II. The Chemical Composition of Butter-fat. III. The Chemistry of Rancidity in Butter-fat. BY C. A. BROWNE, JR. *J. Am. Chem. Soc.*, 21, 807-827; 975-994.—II. By methods involving fractional precipitation of the insoluble acids from alcohol, and solution of the soluble acids in water at different temperatures, the author has made a complete analysis of butter-fat with the following results:

| Acid. | Per cent. of acid. | Per cent. of triglycerides. |
|-------------------|--------------------|-----------------------------|
| Dioxystearic..... | 1.00 | 1.04 |
| Oleic..... | 32.50 | 33.95 |
| Stearic..... | 1.83 | 1.91 |
| Palmitic..... | 38.61 | 40.51 |
| Myristic..... | 9.89 | 10.44 |
| Lauric..... | 2.57 | 2.73 |
| Capric..... | 0.32 | 0.34 |
| Caprylic..... | 0.49 | 0.53 |
| Caproic..... | 2.09 | 2.32 |
| Butyric..... | 5.45 | 6.23 |
| Total..... | 94.75 | 100.00 |

III. The three factors most active in the production of rancidity in fats are openness to air, exposure to light, and degree of warmth. One of the chief changes produced consists in the decomposition of the oleic acid, which is partly broken down

into compounds having an aldehydic nature, as well as into lower oxy-acids. Another marked effect of rancidity upon fats is in the marked decrease in the heat of combustion.

Notes on Testing Soils for Application of Commercial Fertilizers. BY H. A. WEBER. *J. Am. Chem. Soc.*, **21**, 1095-1099. —Small samples of soils of about five kilograms each are mixed with various fertilizers. Several seeds of different kinds of grain are added to each sample, and the differences in the growth and condition of the plants noted from time to time. From the results of this simple test the needs of the particular soil can be readily learned.

Studies on Bread and Bread-making. BY HARRY SNYDER AND L. A. VOORHEES. *U. S. Dept. Agr., Expt. Sta. Bull.* **67**, 1-51. —Among the more important changes which have been found to take place in baking bread the following may be noted : (1) The starch undergoes both physical and chemical changes. From 3 to 4 per cent. of soluble carbohydrates are found in bread, showing that less than eight per cent. of the total starch is rendered soluble. (2) The amount of water-soluble proteid which is formed depends upon the degree of acidity of the dough. (3) The physical properties of bread are determined largely by the expansive power of the gluten of the flour. (4) At high temperatures there is a partial volatilization of the vegetable fat in bread, especially when escaping water vapor is present ; and, furthermore, an oxidation of residual organic matter takes place. When an animal fat is added there seems to be an occlusion of fat, probably due to the formation of dextrin.

A Description of Some Chinese Vegetable Food Materials and Their Nutritive and Economic Value. BY WALTER C. BLASDALE. *U. S. Dept. Agr., Expt. Sta. Bull.* **68**, 1-48. —A number of species of Chinese vegetables, as found in the San Francisco market, amounting to about 50 varieties in all, were collected, identified botanically, and in most cases submitted to chemical analysis. The analytical methods employed were, in the main, the official ones. The results which are given add much to our knowledge of the chemical composition of Chinese food materials.

Commercial Fertilizers. *N. J. Agr. Exp. Sta., Bull.* **139**, 1-59 ; *Me. Agr. Expt. Sta., Bull.* **53**, 57-70 ; *N. Y. Agr. Expt. Sta., Bull.* **160**, 63-151.

On Nitrites as a Product of Combustion. BY EDWARD W. AXSON. *Tech. Quart.*, **12**, 219-225. —The author has made quantitative experiments on the amount of nitrites formed dur-

ing combustion and in breathing, in order to determine the best conditions for absorption and the comparative amounts of nitrite obtained from various sources. A test was also made of the physiological effects of breathing air high in nitrites.

The Action of Hepatic, Renal, and Other Cells on Phenol and Indol, under Normal and Pathological Conditions. BY C. A. HERTER AND A. J. WAKEMAN. *J. Expt. Medicine*, 4, 307-326. —In this study of the natural defenses of the organism against injury through chemical agencies indol and phenol were selected for use, because they are normal products of proteid cleavage in the intestine, and are often found in abnormal quantities in the course of digestive derangement. In the "contact" method of study the organs of healthy rabbits were chopped into fine bits, and a definite weight brought into contact with weak solutions of phenol and indol. After some time the mixture was distilled, and the presence of phenol and indol shown in the distillate by color reactions. In the "infusion" method intravenous injections were made of solutions of phenol and indol. In general, the order of activity of the cells was found to be liver, kidney, muscle, brain, and blood. Only in the case of the liver was it possible to get satisfactory results under pathological conditions. The prolonged action of chloroform and of ether decreased the power of the liver cells in the conversion of phenol and indol. Alcohol was found to be without appreciable effect. From these and further experiments with a number of poisons the conclusion is drawn that no pathological conditions which can be induced in the liver during life are capable of destroying or limiting the activity of its cells in causing the conversion of phenol and indol.

The Relation of Dextrose to the Production of Toxin in Bouillon Cultures of the Diphtheria Bacillus. BY THEOBALD SMITH. *J. Expt. Medicine*, 4, 373-397. —The author has found that contrary to the usual ideas dextrose is not in itself inimical to toxin production, but that a certain amount of it is necessary for abundant toxin accumulation. If added in quantities not greater than 0.2 per cent. to peptone bouillon freed from fermentable acid-producing substances, it leads to the maximum accumulation of toxin by utilizing the available peptone to the best advantage. The lesser yield of toxin in ordinary unfermented peptone bouillon containing muscle sugar may be explained by the assumption that the acid products of muscle sugar are different from those of dextrose and non-utilizable, or else that the bouillon contains unknown inhibitory substances removed during fermentation.

The Origin of Fat from Protein in the So-called Fatty Metamorphosis of Phosphorus Poisoning. BY ALONZO

ENGLEBERT TAYLOR. *J. Expt. Medicine*, 4, 399-407.—In this study of fatty degeneration a certain number of frogs, all of the same sex, of approximately the same weight, selected at the same time, and kept awake and without food for the same period, were divided into equal groups. One-half of the number were poisoned with phosphorus, the other half formed a control group. The dried residue of the poisoned frogs weighed 16.5 per cent. less than that of the control group; it contained 18.45 per cent. less protein, 22.64 per cent. less fat, and about 13.3 per cent. less glycogen. While these results differ from those of other investigators, it is felt that the more rigid conditions obtaining in the present study render the conclusion that no fat is produced from protein the more probable one.

Experiments on the Conservation of Energy in the Human Body. BY W. O. ATWATER AND E. B. ROSA. *U. S. Dept. Agr., Expt. Sta. Bull.* 63, 74-94; *Phys. Rev.*, 9, 238-251.—The authors describe one or two of the earlier experiments made on men with their modified form of respiration calorimeter. They find a fairly close correspondence between the estimated income and the measured outgo of energy, the difference being practically less than the limits of experimental error. The experiments, in general, demonstrate the applicability of the law of the conservation of energy to the human organism.

Experiments on the Metabolism of Matter and Energy in the Human Body. BY W. O. ATWATER AND F. G. BENEDICT. *U. S. Dept. Agr., Expt. Sta., Bull.* 69, 1-112.—This bulletin contains detailed descriptions of six experiments made on the metabolism of matter and energy in human subjects by the use of a respiration calorimeter. Various improvements in the methods of sampling the food materials used and in the methods of examination of the waste materials are described. The accuracy of the apparatus and of the methods for the determination of carbon dioxide, water, and heat was tested with an electric current, by which known amounts of heat were produced in the chamber of the apparatus, and by burning alcohol in the chamber, thus producing known amounts of carbon dioxide, water, and heat.

The Influence of the Presence of Pure Metals upon Plants. BY EDWIN B. COPELAND AND LOUIS KAHLENBERG. *Trans. Wis. Acad. Sciences, Arts, and Letters*, 22, 454-474.—Nageli concluded from a study of this subject that pure water is harmless, but that various metals in infinitesimal quantities are deadly. He was convinced that the injury done to the plant was of a different nature from ordinary poisoning and proposed for the new phenomenon the name of "Oligodynamic effects." The

authors do not accept this explanation, but consider the result to be due to the presence of metallic salts formed by the action of the oxygen or the carbonic acid of the water or of the water itself. In studying this question, a number of experiments have been carried out in glass beakers coated with paraffin to remove the disturbing influence of the glass. The metals were used where possible, in the form of foil, in order to expose a large surface; the seedlings used were average plants selected from a large number. At the beginning of the experiment a mark was made 10 mm. from the apex of the root and the excess in length of these spaces over the original was noted daily. The condition of the metals was also observed at the end of the experiment. The injury to the plant was found to depend largely upon two factors; namely, on the tendency of the metal to go into solution as a chemical compound or salt, and on the specific toxicity of the metal when in solution in the form of such salts. In regard to the first factor, it was found that the relative power of those metals in causing injury was closely related to the magnitude of their solution tension; concerning the second, it was found that in general those metals poison plants when present in water whose salts are already known to be toxic.

On the Excretion of Kynurenic Acid. BY LAFAYETTE B. MENDEL AND HOLMES C. JACKSON. *Am. J. Physiology*, 2, 1-28.—Kynurenic acid is, with only one exception, the only quinoline compound discovered in connection with the animal body. The object of the authors was to study the conditions which determine and modify the production and excretion of kynurenic acid. Experiments were made on dogs which were fed on definite quantities of food, the excreted nitrogen and kynurenic acid being determined by analysis. The results obtained indicate that kynurenic acid excretion accompanies accelerated proteid decomposition and is directly dependent on the proteid katabolism. Similar results are given by the ingestion of both animal and vegetable proteids as well as proteoses, but gelatin, like the carbohydrates, does not give rise to kynurenic acid in metabolism. Under the influence of foods lacking in protein the kynurenic acid excretion is greatly diminished or absent. Kynurenic acid has not been found in the urine of any animal other than the dog.

The Origin of Fibrinogen. BY ALBERT MATHEWS. *Am. J. Physiology*, 3, 53-85.—It is shown by a number of experiments that after defibrination of the blood of cats the fibrinogen is rapidly re-formed, the amount becoming normal again in two or three days. This re-formation of the fibrinogen takes place in the absence of the spleen, pancreas, kidneys, reproductive organs or brain, but does not take place to any appreciable extent if the small and large

intestines be removed. The paraglobulin of the blood is not converted into fibrinogen outside the body nor by the skin or more remote tissues. The blood of the inferior vena cava both above and below the kidneys is poorer in fibrinogen than is the carotid blood, while the blood of the mesenteric vein is constantly somewhat richer in fibrinogen than is the arterial blood. Fibrinogen is not derived directly from the proteid constituents of food, since it is readily re-formed after six to ten days' fasting; the fibrinogen content of the blood does not diminish during fasting. If, however, leucocytosis be prolonged for several days the fibrinogen content of the blood increases. These various observations point to the decomposing leucocytes of the blood, and chiefly those of the intestinal area, as being the source of the fibrinogen of the blood, although it is hardly possible as yet to regard the evidence as conclusive.

On Metabolism during a Combination of Phosphorus Poisoning and Phlorhizon Diabetes. BY W. E. RAY, T. S. McDERMOTT, AND GRAHAM LUSK. *Am. J. Physiology*, 3, 139-155. —In dogs diabetic with phlorhizin phosphorus poisoning does not cause any noteworthy increase in proteid metabolism or change the sugar excretion; in dogs poisoned with phosphorus, however, the administration of phlorhizin brings about not only the usual preliminary sweeping out of the body sugars and the establishment of the customary ratio between urinary dextrose and nitrogen, but also causes an increase in proteid metabolism. The authors consider the high proteid decomposition in phlorhizin diabetes to be due to the non-burning of the carbohydrate-like radical of the proteid molecule. In phosphorus poisoning the proteid decomposition is due to the fatty degeneration of the carbohydrate radical. The fatty infiltration noticed in post-mortem examinations is due to the action of pathologically hungry cells which attract the fat to themselves in greater quantities than can be utilized.

A Preliminary Note on the Fractional Precipitation of the Globulin and Albumin of Normal Horse's Serum and Diphtheric Serum, and the Antitoxic Strength of the Precipitates. BY JAMES P. ATKINSON. *J. Expt. Medicine*, 4, 649-650. —In this preliminary paper attention is called to the compounds obtained from the globulin of horse's serum by fractional precipitation with sodium chloride at temperatures between room temperature and 72° C. The same phenomenon is noticed in the serum itself after removal of the globulin, precipitation beginning at 56° C. and being complete at 81°. Each fraction of the antitoxic globulin is found to possess antitoxic power, while the final filtrate is free from antitoxin.

Observations on the Nitrogenous Metabolism of the Cat, Especially on the Excretion of Uric Acid and Allantoin. BY LAFAYETTE B. MENDEL AND ERNEST W. BROWN. *Am. J. Physiology*, 3, 261-270.—The results of a number of experiments show that kynurenic acid is not excreted by the cat, even under conditions of increased proteid metabolism. An increase, however, in the excretion of uric acid is brought about by feeding the animals with thymus and pancreas tissue, as is also the case with man and with the dog. The excretion of allantoin is noticeable after the ingestion of thymus and pancreas tissue or uric acid, but preliminary experiments have failed to show the production of allantoin after the administration of hydrazine sulphate.

On the Occurrence of Iodine in the Thymus and Thyroid Glands. BY LAFAYETTE B. MENDEL. *Am. J. Physiology*, 3, 285-290.—The author concludes that there is no evidence to show that the carefully isolated thymus of man or animals contains iodine, and considers the traces found by other observers to be due to adherent thyroïdal tissue. The results of several observations present confirmatory evidence of the absence of iodine in the thyroid glands of newly-born children. The accessory thyroids in man sometimes contain more iodine than the thyroids proper.

On the Chemical Reaction of the Intestinal Contents to Various Indicators, and on the Nature of the Contents Escaping from a Fistula Immediately above the Ileo-caecal Valve. BY B. MOORE AND T. J. BERGIN. *Am. J. Physiology*, 3, 316-325.—The alkaline reaction of the intestine to methyl orange, lacmoid, and litmus, shows the absence of hydrochloric acid, and of all stronger organic acids as acetic, lactic, or butyric, which would be formed in the bacterial decomposition of carbohydrates or fats. The acid reaction of the intestine to phenolphthalein the authors consider due to the excess of dissolved carbonic acid. The chemical nature of the substance escaping from the fistula indicates that the absorption of foodstuffs, in the dog at least, can be practically completed in the small intestine. A proteolytic enzyme, active in alkaline solution, and a diastatic ferment, also active in alkaline solution, are found in the dog's intestine at this level.

E. H. RICHARDS, REVIEWER.

Rivers Pollution and Water Supplies. BY HERBERT E. SMITH. *Conn. State Board of Health, Ann. Rep.*, 1898, 266-395.—The water supplies of twenty towns in the state have been examined monthly for periods varying from three months to one year. The Naugatuck and Quinnipiac rivers have been exam-

ined during one year at four places each. The results add valuable data for New England water-sheds. There are also given the results of a year's examination of the sewage and effluent from Meriden.

An Investigation of the Action of Water upon Lead, Tin, and Zinc. BY H. W. CLARK. *Mass. State Board of Health, Ann. Rep.*, 30, 541-585.—Eight hundred samples of water from 63 towns in the state were examined. The water from 24 towns showed less than 0.05 parts of lead per 100,000; from 29 towns there was over 0.1 part, and of these 10 samples gave from 0.40 to 8.55, results quite justifying the extensive examination. The method finally used is as follows: 3.5 liters are concentrated to 25-30 cc., ammonium chloride and ammonia are added, and then hydrogen sulphide water. After standing, the hydrogen sulphide is expelled by boiling, and the separated sulphides of iron, lead, copper, and zinc, together with any suspended organic matter, are filtered off, the soluble coloring-matter remaining in the filtrate. The residue is heated with HNO_3 (1 part acid, sp. gr. 1.2, to 5 parts water), the solution filtered, concentrated to 10-15 cc., treated with 5 cc. strong H_2SO_4 , and heated until fumes of the latter come off. If the sample contained less than 0.025 part per 100,000 of iron, it is removed by ammonia and the lead determined in the filtrate. If, however, there is a larger amount, the lead sulphate is washed with 50 per cent. alcohol until free from iron, and then dissolved in ammonium acetate and the depth of color, given by freshly prepared hydrogen sulphide, compared with that of standards. Copper rarely interferes, and zinc is easily separated and determined.

Report on the Investigations into the Purification of the Ohio River Water at Cincinnati. BY GEORGE W. FULLER. *Cincinnati*, 1899, 1-620.—In addition to many valuable data on water purification from the mechanical and bacteriological point of view, this report contains the results of daily examinations of the Ohio River water over a period of two months, as compared with the averages of the previous year, and also analyses of the various effluents. There is, in addition, an account of experiments with lime as a coagulant for suspended clay, combined with subsequent treatment by carbon dioxide to remove the excess of lime.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

ORGANIC CHEMISTRY.

J. F. NORRIS, REVIEWER.

The Rate of Action of Water on Certain α -, β -, and γ -Halogen Substituted Fatty Acids. BY EDWIN DEBARR. *Am. Chem.*

J., 22, 333-351.—In order to determine the influence of the position of the halogen atom on the decomposition of substituted fatty acids by water, a number of acids were heated with water in sealed tubes at 150°, as it was found that the reaction could be most readily studied under these conditions. The figures given in the following table are selected from the large number obtained. In the first column are given the percentages of transformation of the respective acids at the end of one-half hour. The second column gives the time in hours when transformation ceased, and the third column the total amount changed in this time:

| Acid. | I. | II. | III. |
|-------------------------------|--------|---------------|--------|
| Monochloracetic | 4.06 | 30 | 47.11 |
| Dichloracetic | 5.32 | 5 | 17.76 |
| Trichloracetic | 42.38 | 8 | 100.00 |
| α -Chlorpropionic..... | 4.42 | 3 | 11.41 |
| α -Brompropionic..... | 2.93 | 2 | 7.06 |
| α -Brombutyric..... | 3.77 | 3 | 9.25 |
| α -Chlorbutyric..... | 5.80 | 3 | 7.50 |
| β -Chlorpropionic..... | 41.50 | 4 | 50.44 |
| β -Chlorbutyric..... | 29.97 | 3 | 37.38 |
| γ -Chlorbutyric..... | 100.00 | $\frac{1}{2}$ | 100.00 |

The order in which decomposition takes place is, excepting in the case of mono-, di-, and trichloracetic acid, not the same as is that of the affinity constants of the acids. The order of the stability of the compounds is, however, the same as that of the

affinity. The influence of the distance of the halogen from the carboxyl group is clearly shown with the butyric acids, the rate of transformation rapidly increasing the further the halogen atom is removed from the carboxyl group. Care was taken to obtain the acids necessary for the investigation in a state of purity. As a result the physical constants determined are more trustworthy than those heretofore obtained. β -Chlorpropionic acid melts at 61° and boils at 204° . β -Chlorbutyric acid melts at 16° – 16.5° and boils at 116° at 22 mm. pressure. γ -Chlorbutyric acid boils at 196° (22 mm.) and melts at 12° .

On the Nature of the Oxyazo Compounds. BY WILLIAM MCPHERSON. *Am. Chem. J.*, **22**, 364–384.—From the work of previous investigators to determine the nature of the oxyazo compounds, it has been impossible to decide which of the following formulæ expresses the structure of these compounds: $\text{HO.R.N} : \text{N.C}_6\text{H}_5$, $\text{O.R} : \text{N—NH.C}_6\text{H}_5$. The author has obtained decisive evidence by studying the action of unsymmetrical alkylated and acylated derivatives of phenylhydrazine on ortho and para quinones. The condensation-products thus obtained, $\text{O.R} : \text{N—N.R'.C}_6\text{H}_5$, were compared with the free oxyazo compounds and the corresponding products obtained from these by direct alkylation and acylation. The results prove that all paraoxyazo compounds, as well as their salts and substitution-products, possess the general formula $\text{MO.R.N} : \text{N.C}_6\text{H}_5$ ($\text{M}=\text{H}$, a metal, acyl, or alkyl). The work in the ortho series, while not so decisive, points to the conclusion that these compounds and their acylated derivatives are monohydrazones of orthodiketones, $\text{O.R} : \text{N—N.M.C}_6\text{H}_5$ ($\text{M}=\text{H}$ or acyl). The alkylated substitution-products, on the other hand, are azo compounds, $\text{R'O.R.N} : \text{N.C}_6\text{H}_5$. Quinonebenzoylphenylhydrazone was prepared by mixing aqueous solutions of quinone and α -benzoylphenylhydrazine hydrochloride. The yellow precipitate formed melted at 171° after crystallization from benzene. The compound, when reduced with zinc and acetic acid, was split quantitatively into benzanilide and p -amidophenol. It was converted by acids and alkalis into benzoic acid and p -oxyazobenzene. The hydrazone which, from its method of synthesis and its properties, must have the structure represented by the formula $\text{O} : \text{C}_6\text{H}_4 : \text{N.N.C}_6\text{H}_5.\text{COC}_6\text{H}_5$ is isomeric, not identical, with the compound formed by introducing the benzoyl group into p -oxyazobenzene. This latter substance must have, therefore, the structure $\text{C}_6\text{H}_5\text{CO.O.C}_6\text{H}_4.\text{N} : \text{NC}_6\text{H}_5$. From the following facts the conclusion is drawn that p -oxyazobenzene is a true azo compound : (1) In the derivatives formed by the introduction of acyl or alkyl groups these groups are joined to oxygen. (2) It has been shown by Goldschmidt and others that o -oxyazo derivatives

by direct acylation yield compounds which contain the acyl group joined to nitrogen. (3) Free *p*-oxyazo compounds do not react with phenylhydrazine, whereas all *p*-quinonebenzoylphenylhydrazine derivatives, like benzoquinone itself, react with this reagent with explosive violence. (4) The *p*-oxyazo compounds are soluble in dilute alkalis. The *o*-oxyazo compounds of the naphthalene series, however, are not affected by even concentrated caustic alkalis. (5) The study of the physical properties of the *p*-oxyazo compounds leads to results in accord with those obtained by chemical methods. The acetate of *p*-oxyazobenzene must have the structure $C_6H_5 \cdot N : N \cdot C_6H_4 \cdot O \cdot CO \cdot CH_3$, since it is not identical with quinoneacetylphenylhydrazine (m. p. 118°) made by the action of α -acetylphenylhydrazine on quinone. The following hydrazones were prepared and compared with the corresponding derivative of the oxyazo compounds with analogous results: Toluquinonebenzoylphenylhydrazine (m. p. 151°), thymoquinonebenzoylphenylhydrazine (m. p. 132°), α -naphthoquinonebenzoylphenylhydrazine (m. p. 161.5°). When benzoquinone and α -methylphenylhydrazine hydrochloride were brought together in dilute aqueous solution, an evolution of nitrogen took place and dimethyldiphenyltetrazone (m. p. 133°) separated. From α -benzylphenylhydrazine an analogous benzyl derivative (m. p. 145°) was prepared. When α -naphthoquinone was used, however, a hydrazone was formed similar in structure to the compounds prepared from the acylated hydrazines. The methyl derivative melts at 118.5° and the benzyl derivative at 136° . The benzyl ether of benzene azo- α -naphthol (m. p. 102°), which is isomeric with the latter compound, was prepared from the azo compound and benzyl chloride. When an orthoquinone was studied the results obtained were different from those described alone. The compound formed by treating β -naphthoquinonehydrazone with benzoyl chloride was found to be identical with the hydrazone prepared by the action of α -benzoylphenylhydrazine on β -naphthoquinone. The compound, which must contain the benzoyl group joined to nitrogen, crystallizes from benzene-ligroin and melts at 191° . When the methyl ethers were made, however, two compounds were obtained, an azo body (m. p. 95°) and a quinonehydrazone (m. p. 134.5°).

The Action of Benzoyl Chloride on the Phenylhydrazones of Benzoin. By PAUL C. FREER. *Am. Chem. J.*, **22**, 396-402.—In a previous paper (*this Rev.*, **5**, 32; see also *this Rev.*, **5**, 125) the author described a compound formed by the action of benzoyl chloride on β -benzoinphenylhydrazine. From an analysis and a molecular weight determination of the substance, it appeared that the chloride had simply effected a molecular rearrangement

and that the compound was a third phenylhydrazone of benzoin. The reaction has been investigated further and the reaction-product described found to be benzanilide. The reaction is a complex one, as the following substances were isolated in addition to benzanilide: benzil, lophine, dibenzanilide, hydrochloric acid, ammonium chloride, aniline hydrochloride, and a large amount of tar. When nitrobenzoyl chloride was used no lophine was formed. The probable course of the reaction by which the above-mentioned compounds are formed is fully explained. Nitrobenzoyl chloride reacts readily with both α - and β -benzoinphenylhydrazone, whereas benzoyl chloride does not react with the α -variety at winter temperature.

Notes on the Space Isomerism of the Toluquinoneoxime Ethers. BY WILLIAM CONGER MORGAN. *Am. Chem. J.*, **22**, 402-407.—In a former paper (*this Rev.*, **5**, 30) it was stated that certain ethers of toluquinonemetaoxime, whether formed by the action of hydroxylamine on the quinone or by nitrous acid on the corresponding cresol, showed evidence of existing in isomeric forms. By fractional crystallization of the benzoyl ester two substances have been obtained, one melting at 193° and one melting approximately at 144° . The low-melting compound, which was not obtained in a state of purity, is changed slowly into the high-melting form by repeated crystallizations from alcohol. When heated at 120° with alcohol the change is rapid and complete. The formation of isomers has been noted in the case of ethers prepared from acid chlorides and the sodium salt of the oxime made by the action of amyl nitrite on the sodium salt of the cresol. Under these circumstances the chance of the formation of side-products which would effect the purity of the ether is small, and, consequently, the results obtained indicate that the isomerism is due to the space relation of the atoms. The following-named substances are described: The sodium salt of toluquinone-*m*-oxime, bromtoluquinone-*o*-oxime benzoyl ether (m. p. 184°), toluquinone-*o*-oxime benzoyl ether dichloride (m. p. 149°), chlortoluquinone-*o*-oxime benzoyl ether (m. p. 185 – 193° with decomposition).

On the Constitution of α -Dibromdinitrobenzol—Paradibromorthodinitrobenzol. BY D. F. CALHANE AND P. M. WHEELER. *Am. Chem. J.*, **22**, 449-458.—When β -dibrombenzene is treated with a mixture of fuming nitric acid and sulphuric acid, the resulting product consists chiefly of β -dibromdinitrobenzene ($\text{BrI}, \text{NO}_2, \text{Br}_4, \text{NO}_2, 6$)

and a small quantity of α -dibromdinitrobenzene. The authors show that the structure of the latter compound is represented by the formula $\text{C}_6\text{H}_2\text{Br}_2\text{NO}_2(\text{BrI}, 2\text{NO}_2, 3, \text{Br}_4)$. This fact was estab-

lished by converting the compound into a dibromphenylenediamine (m. p. 94° – 95°) from which *o*-phenylenediamine was obtained by prolonged treatment with sodium amalgam. This result was confirmed by treating the *p*-dibromphenylenediamine with phenanthrenequinone, which gave a dibromphenanthrophenazine (m. p. 297°), and also by treating the diamine with benzil, when dibromdiphenylchinoxaline (m. p. 215° – 216°) was formed. As such compounds are formed only from *o*-diamines the structure of α -dibromdinitrobenzene was established since it was prepared from *p*-dibrombenzene.

Phenyl Mustard Oil as a Reagent for the Detection of the Alcoholic Hydroxyl Group. BY W. R. ORNDORFF AND F. A. RICHMOND. *Am. Chem. J.*, **22**, 458–473.—The action of phenyl mustard oil on a large number of compounds was studied, in order to discover if it exhibited the marked chemical reactivity which is characteristic of phenyl isocyanate. Its use as a reagent for the detection of the hydroxyl group is limited. It reacts to form well-crystallized compounds with primary, secondary, and tertiary alcohols, but it does not combine with unsaturated alcohols, acids, phenols, or alcohols of the benzene series. The addition-products of phenyl mustard oil and the following alcohols are carefully described: methyl, ethyl, propyl, isopropyl, isobutyl, tertiary butyl, and isoamyl alcohol. When phenyl mustard oil was heated with allyl alcohol, diphenyl urea was formed, and when glycol and glycerine were used, the chief reaction-product was thiocarbanilide. By the action of phenol on phenyl mustard oil thiocarbanilide was formed, and not the phenyl ester of thiocarbamic acid which, according to the literature, is the product of this reaction.

The Ethers of Isonitrosoguiacol in Their Relation to the Space Isomerism of Nitrogen. BY JOHN L. BRIDGE AND WILLIAM CONGER MORGAN. *Am. Chem. J.*, **22**, 484–489.—Since the authors have noted the existence of stereoisomerism in the case of certain quinoneoximes, it seemed advisable to repeat the work of previous investigators on isonitrosoguiacol in order to discover if isomerism exists in the derivatives of this compound. A study of the compounds already described, in addition to the benzoyl ether isonitrosoguiacol (m. p. 188° when “dipped” for ten seconds) and its dibromide (m. p. 153° – 154°) and monobromisonitrosoguiacol benzoyl ether led to the discovery of no case of stereoisomerism.

Diazocaffeine. BY M. GOMBERG. *Am. Chem. J.*, **23**, 51–70.—When amidocaffeine is dissolved in strong hydrochloric acid and treated with nitrous acid, a diazo compound is formed, which is stable only in solution at a low temperature. Diazo-

caffeine reacts with aromatic phenols and amines with the formation of azo compounds, which crystallize well and possess intense dyeing power. The azo dyes prepared from phenol, dimethylaniline, phenylenediamine, and β -naphthol are described in detail. That the caffeine molecule is not broken up by the action of nitrous acid, but that a true diazo salt of caffeine is formed was shown in two ways. First, when caffeine instead of its amido derivative was subjected to the same treatment with nitrous acid, it remained entirely unchanged; and second, the azo dyes on treatment with stannous chloride furnished almost quantitatively amidocaffeine and the corresponding aromatic body. The condensation-product of acetoacetic acid and diazo-caffeine is not similar in structure to the compound found under like conditions with aromatic diazo salts. The caffeine derivative is a diazo compound, $\text{CH}_3\text{COC}(\text{N}_2\cdot\text{C}_8\text{H}_9\text{N}_4\text{O}_2)_2\cdot\text{COOH}$, whereas diazo benzene chloride and acetoacetic ester give a hydrazo and a formazyl compound. Propyl and benzylacetoacetic acids give analogous compounds, the introduction of two diazo residues being made possible by the elimination of the acetyl group as acetic acid. The condensation-products,



were obtained as dark crystalline powders which could be heated to 285° without melting and without decomposition. Diazocaffeine and nitroethane react readily with the formation of a substance of the structure $\text{NO}_2\text{C}\cdot\text{CH}_3\cdot(\text{N}_2\text{C}_8\text{H}_9\text{N}_4\text{O}_2)_2$. The compound crystallizes from a mixture of chloroform and ether in deep-blue flakes, melts at 218° – 219° , and shows marked changes in color when heated with water. Nitropropane forms an analogous compound (m. p. 237° – 238°).

The Action of Ethyl Iodide on Tartaric Ester and Sodium Ethylate. BY JOHN E. BUCHER. *Am. Chem. J.*, 23, 70–83.—Previous investigators have found it impossible to prepare symmetrical diethoxysuccinic ester by the usual synthetical methods. Neither the mono- nor disodium derivative of tartaric ester reacts with methyl or ethyl iodide, and symmetrical dibromsuccinic ester gives unsymmetrical esters when treated with alkyl halides. The author studied carefully the action of ethyl iodide on tartaric ester in the presence of sodium ethylate, and found among the products of the reaction three forms of diethoxysuccinic ester; *viz.*, the unsymmetrical and inactive and *d*-symmetrical varieties. Some of the monoethoxy derivative was also present. The proportions of the different substances varied as the proportions of the reacting substances were changed. The diethoxy derivatives were separated by saponifying the esters and adding calcium chloride when the calcium salt of unsym-

metrical diethoxysuccinic acid was precipitated. The symmetrical acid, obtained by extracting the acidified filtrate with ether, melts at 97° – 99° and forms very soluble crystalline potassium and barium salts. Hydroxyethoxysuccinic acid was isolated by precipitating its lead salt. The probable course of the reaction which results in the formation of an unsymmetrical derivative from a symmetrical compound is explained by the author. Preliminary experiments indicate the formation of oxalacetic ester as an intermediate product in the reaction.

Action of Picryl Chloride on Pyrocatechin in Presence of Alkalies. BY H. W. HILLYER. *Am. Chem. J.*, **23**, 125–128.—A compound, the constitution of which is represented by the

formula, $\text{C}_6\text{H}_4 \begin{array}{c} \diagup \text{O} \diagdown \\ \diagdown \text{O} \diagup \end{array} \text{C}_6\text{H}_2(\text{NO}_2)_2$, is readily formed when an alco-

holic solution of picryl chloride and pyrocatechin containing sodium hydroxide is heated at 60° – 70° for six hours. The author proposes to name the substance of which the above compound is a dinitro derivative, phenoxozone, on account of its analogy to phenoxazine, which is made in a similar way from picryl chloride and *o*-amidophenol, and possesses the structure

$\text{C}_6\text{H}_4 \begin{array}{c} \diagup \text{NH} \diagdown \\ \diagdown \text{O} \diagup \end{array} \text{C}_6\text{H}_2(\text{NO}_2)_2$. Dinitrophenoxozone crystallizes from

benzene, melts at 192° – 192.5° , and sublimes unchanged in the form of yellow needles.

Nitroso Derivatives of Caryophyllene and Cadinene and Their Bearing on the Characterization and Classification of the Sesquiterpenes. BY OSWALD SCHREIMER AND EDWARD KREMERS. *Pharm. Archives*, **2**, 273–301.—A number of derivatives of caryophyllene and cadinene were prepared and carefully studied. As the substances have well-characterized physical properties they will materially assist in the study of the above compounds as well as in the investigation of other sesquiterpenes. Caryophyllene nitrosite crystallizes in deep-blue needles, melts at 113° , and has the rotation $[\alpha]_D = +102.95$ in benzene solution. It reacts with benzylamine, forming a white crystalline compound, which melts at 167° . When exposed to the sunlight in benzene solution about 29 per cent. of the nitrogen is liberated and the β -compound is formed (m. p. 146° – 148°). In alcoholic solution a similar reaction takes place and a third isomer, the α -compound, is formed. It melts at 113° – 114° , and is either slightly dextrogyrate or inactive. By a new method of preparation a good yield of caryophyllene nitrosochloride (m. p. 158°) was obtained. The nitrosochloride and benzylamine react

readily with the formation of two nitrolbenzylamine bases (m. p. 128° and 169°). The nitrosate of the terpene melts at 148° – 149° and forms with benzylamine a nitrol base (m. p. 128°), which is identical with the one obtained from the nitrosochloride. Contrary to the statement in the literature, the authors were able to prepare a crystalline hydrochloride of caryophyllene (m. p. 69° – 70°). Cadinene forms a nitrosate, which melts with decomposition at 105° – 110° , and a nitrosochloride which melts at 93° – 94° .

A Preliminary Communication upon Ricinine. BY THOMAS EVANS. *J. Am. Chem. Soc.*, **22**, 39–46.—The author shows that the substance obtained by Tuson by extracting castor beans with boiling water, to which the name ricinine was given, is identical with ricidine, which was isolated by Schulze from the same source by a different method of extraction. The compound crystallizes in small colorless prisms, melts at 193° , and gives results on analysis agreeing closely with the formulæ $C_{16}H_{16}N_4O_4$ and $C_{16}H_{14}N_4O_4$. The formation of a chlorplatinate, described by Tuson, was probably due to the presence of an impurity in the ricinine investigated, since the pure compound does not form such a salt. It does not give a precipitate with silver nitrate, mercuric nitrate, or mercuric chloride, but on long standing a concentrated solution of ricinine and mercuric chloride yield a feathery crystalline product. By brominating ricinine a substitution-product (m. p. 232°) containing two bromine atoms was obtained. On oxidation with alkaline potassium permanganate a crystalline acid, which melted at 279° – 280° , was obtained.

Benzenestearosulphonic Acid and Other Sulphonic Acids Containing the Stearic Radical. BY E. TWITCHELL. *J. Am. Chem. Soc.*, **22**, 22–26.—Benzenestearosulphonic acid, $C_{18}H_{35}SO_3H$, $C_{18}H_{33}O_2$, was prepared by treating a mixture of oleic acid and benzene with concentrated sulphuric acid. The acid is a sticky, semisolid mass, soluble in water, and forms alkaline salts which are readily precipitated by acids, bases, or salts. Analogous compounds were prepared from naphthalene and phenol.

METALLURGICAL CHEMISTRY.

H. O. HOFMAN, REVIEWER.

The Ultimate and Rational Analysis of Clays and Their Relative Advantages. BY H. RIES. *Trans. Am. Inst. Min. Eng.*, **28**, 160–166.—The rational analysis of a clay which in its simplest form gives the three mineral constituents, kaolinite, feldspar, and quartz, consists in decomposing and dissolving the

kaolinite with sulphuric acid followed by caustic soda, weighing the residual feldspar and quartz, determining the alumina in it, and then calculating the feldspar. Its value, especially with fire clays containing a small percentage of fluxing impurities (iron, lime, and magnesia) lies in the fact that it gives much information as to the behavior of a clay in shrinking and melting, which the ultimate analysis does not give.

A Modification of Bischof's method for Determining the Fusibility of Clay, as Applied to Non-refractory Clays, and the Resistance of Fire-clays to Fluxes. BY H. O. HOFMAN. *Trans. Am. Inst. Min. Eng.*, 28, 435-440.—There are two leading methods of testing clays, the direct one of Seger and the indirect one of Bischof. In the former, a clay to be tested is compared with the standard series of Seger; in the latter a clay is toned up with a silica-alumina mixture until it shows in the fire the same behavior as the most refractory clay known, that of Saarau. Instead of the Saarau clay the author chose the Seger cone No. 26, which forms the line of separation between refractory and non-refractory clays. He toned up a number of non-refractory clays until they behaved in the fire in the same manner as did the Seger cone No. 26, and tested the resistance of fire-clays to fluxes by mixing weighed samples of 1.5 grams severally with increasing amounts of fluxes until they yielded to the heat at which the sample cone bent over. By this modification of Bischof's method two things can be accomplished, the finding out, first, how much high-grade material is to be added to one of an inferior character to bring it up to a certain standard, and, second, how the resistance of acid or neutral materials to the corroding influences of bases, or vice-versa, can be determined.

Does the Size of Particles Have Any Influence in Determining the Resistance of Fire-clays to Heat and Fluxes. BY H. O. HOFMAN AND B. STOUGHTON. *Trans. Am. Inst. Min. Eng.*, 28, 440-444.—In testing fire-clays and fire-brick in the laboratory, the first step is to grind them to an impalpable powder. The objection made to this procedure is that the behavior of a brick which is a mixture of coarse and fine material in the fire must be different from that of the same material when finely ground. The experiments made with the material just as it is going to be used in making the brick and after fine grinding, prove that in the laboratory practically the same results are obtained with respect to resistance to heat as well as to fluxes, whether the material used be finely ground or not.

Testing Lead-tin and Lead-antimony Alloys. BY J. RICHARDS. *J. Franklin Inst.*, 147, 398-400; *Iron Age*, 63, 12.—The author prepared alloys of lead with 1-24 per cent. antimony, the largest amount that will alloy with lead, cast them into bullets to be used as standards for determining by direct weight the percentage of antimony in hard lead, cast in the same mold into bullets. The anomalous fact that 2 per cent. or less antimony makes the lead-antimony alloy heavier than pure lead, was corrected by preparing a separate set of bullets of lead with 2 per cent. antimony down to pure lead, the amount in each bullet diminishing by 0.1 per cent. These bullets have a frosty appearance and are therefore readily distinguished from the others. The author prepared a similar series of lead-tin alloys in which the tin diminishes by 0.1 per cent.

A Furnace for Smelting Zincose Lead Ores. BY L. KLOZ. *Eng. Min. J.*, 68, 279-280.—The peculiarities of this furnace are that the shaft and boshes consist of cast-iron plates in which water circulates through wrought-iron pipes and that the crucible, made of cast-iron plates, is detached, being brought beneath the furnace on a truck and raised into position by jack-screws.

Notes on Silver Losses in Smelting. BY M. W. ILES. *Eng. Min. J.*, 68, 307-309, 340-341, 367-369.—This paper is replete with data from the author's experiments as metallurgist of the Globe Smelting and Refining Co., Denver, Colorado.

Notes on Lead Smelting and Gold and Silver Refining—Slag Settling Furnaces. BY M. W. ILES. *Eng. Min. J.*, 68, 667-669, 729.—The paper discusses briefly the apparatus used for separating lead-matte from slag outside of the blast-furnace, and gives some facts relating to the reverberatory settling furnace patented by the author, and also several complete analyses of fumes collected by filtering devices.

Potash and Soda Salts from Natural Decomposition of Lead Slags. BY M. W. ILES AND C. F. SHELBY. *Eng. Min. J.*, 67, 650.—At or near the bottom of the slag-heap of the works of the Globe Smelting and Refining Co., at Denver, the authors found a white, efflorescent salt which was formed by the decomposition of the slag through atmospheric agencies. The ultimate analysis gave: SO_3 , 48.45; K_2O , 28.44; Na_2O , 13.48; CaO , 1.80; MgO , 0.80; Fe_2O_3 , 0.29; MnO , 0.26; Cl , 0.47; loss on ignition, 2.40; total, 96.97. These results show that the bases were combined mainly with sulphuric acid, which had been formed by the oxidation of the sulphides held in igneous solution by the slag.

Potash and Soda Salts in Lead Slags. BY R. C. CANBY. *Eng. Min. J.*, 68, 3.—Referring to the preceding paper the author notes the formation of similar potash and soda salts on heaps of some copper matte after exposure to snow, followed by bright, warm sunshine.

Notes on Lead Smelting and Gold and Silver Refining—Fans for Handling Lead Fume. BY M. W. ILES. *Eng. Min. J.*, 68, 788–789.—The larger part of this paper deals with the details of construction of the fans used at the silver-lead works of the Globe Smelting and Refining Co., at Denver. Here the dust-laden gases from the blast-furnace, the zinc retorts, and the silver-melting furnaces, are drawn off by fans and forced through cotton filter-bags.

A Liquid from the Fume of Lead Furnaces. BY M. W. ILES. *Eng. Min. J.*, 68, 576.—The author collected at the works of the Globe Smelting and Refining Co., at Denver, yellow icicles which had formed on a very cold day at the extreme end of the flue which carries the blast-furnace gases and dust into the filtering department. They showed, after dissolving in water, the following composition in grams per liter: FeSO_4 , 88.40; MnSO_4 , 0.68; ZnSO_4 , 24.56; As_2O_3 , 1.45; NaCl , 7.26; Na_2SO_4 , 3.69; K_2SO_4 , 2.22; $(\text{NH}_4)_2\text{SO}_4$, 33.00; H_2SO_4 , 1.22; H_2SO_3 , 15.00; organic matter, 31.94; total, 209.42.

Ammonia in Flue-dust. BY R. C. CANBY. *Eng. Min. J.*, 68, 633.—The author's attention was called to the presence of ammonia in flue-dust from blast-furnaces, when mixed with milk of lime previous to bricking.

Blakemore's Results in Refining Lead by Parkes' Process. BY W. JONES. *Eng. Min. J.*, 68, 273.—Blakemore found that the drosses obtained in the softening furnace and the desilverizing kettle from base bullion rich in gold and copper, were heavy and contained large amounts of gold. The author advocates the method, common in American refineries, of matting the dross in the softening furnace (see Hofman, "Lead," 5th edition, page 435) which leaves nearly all the gold in the lead where it belongs, and greatly reduces the amount of intermediary product requiring retreatment. The author also states that he found little difficulty in separating gold from silver by zincking with base bullion that contained three times as much gold as silver.

Refining Products. BY M. W. ILES. *School Mines Quart.*, 20, 397.—This paper is mainly a table containing forty-eight analyses and assays by H. Alexander of products from the desilverization of base bullion by the Parkes process, at the works of the Globe Smelting and Refining Co., at Denver, Colo.

Silicon and Copper Silicide. BY O. J. STEINHART. *Eng. Min. J.*, 67, 710.—The paper briefly points out the uses to which silicon and copper silicide made by the Cowles Electric Smelting and Aluminum Co., at Lockport, N. Y., can be put. In making iron castings, silicon can take the place of silvery irons; in steel castings low in carbon it does away with the use of ferro-silicon or ferromanganese, which increases the carbon content. Silicon-copper with 10, 15, and 30–35 per cent. silicon is sold in the form of ingots having notches; they weigh 15–18 pounds. It can be used instead of phosphide of copper to promote the soundness of copper and of bronze castings. Small quantities of silicon, up to 0.1 per cent., make the copper stronger than pure copper without materially reducing its electrical conductivity. The following table gives some interesting facts bearing on this matter:

| Per cent. silicon. | Tensile strength, Lbs. per square inch. | Electrical conductivity. |
|-------------------------|--|-----------------------------|
| None (pure copper wire) | 39,825–49,780 | 100 |
| 0.02–0.05 | 64,000 | 98 |
| 0.05–1.1 (with 1.10 Sn) | 118,000 | 43 |
| 0.50 | 71,116 | 28 |
| 3.5 | 135,120 | 7 |

The Influence of Antimony on the Cold-shortness of Brass. BY E. S. SPERRY. *Trans. Am. Inst. Min. Eng.*, 28, 176–190.—As a basis for the experiments, the author chose a high brass containing 60 per cent. copper and 40 per cent. zinc, which would roll both cold and hot, and added varying amounts of antimony in the form of copper-antimony alloy. The molten material was poured into a mould $\frac{5}{8} \times 2\frac{3}{8} \times 24$ inches with the necessary precautions; the plate was cleaned by scraping and then rolled. The experiments showed that brass should not contain over 0.01 per cent. antimony if it is to roll satisfactorily.

The Influence of Bismuth on Brass and Its Relation to Fire-cracks. BY E. S. SPERRY. *Trans. Am. Inst. Min. Eng.*, 28, 427–435.—It is usually believed that bismuth is more deleterious even than antimony in casting brass. For the experiments a high brass of 60 per cent. copper and 40 per cent. zinc was chosen, and varying percentages (0.50, 0.25, 0.09, 0.05, 0.02) of bismuth were added, the alloys were cast into an iron mould to an ingot $\frac{5}{8} \times 2\frac{3}{8} \times 24$ inches and rolled when cold. The conclusions arrived at are that bismuth renders brass cold-short as well as hot-short, and is the cause of fire-cracks. High brass to be cold-rolled should not contain over 0.01 per cent. bismuth.

A New Form of Ingot Mould for Casting Brass or Bronze Ingots, with Remarks on the General Form of Ingots. BY E. S. SPERRY. *Trans. Am. Inst. Min. Eng.*, 28, 246–253.—The

author illustrates a mould made of soft gray iron weighing about 35 pounds which he found suitable for casting ingots weighing 15-25 pounds, also tongs suited both for dumping the mould and handling the ingot while hot.

Reducing-Roasting.—Its Value for Arsenic—Expulsion from Copper Ores and Mattes. BY E. W. SCHERR. *School Mines Quart.*, 21, 66-74.—The paper gives the results obtained by an oxidizing followed by a reducing roast of a mixture of arsenopyrite and a copper matte (Cu, 50.16 per cent. ; Ag, 16.82 ozs. ; Au, 0.18 ozs.), averaging 4.56 per cent. As. The furnace was an 18 × 24 inch American Gas Co. annealing furnace. Two lots of $3\frac{3}{4}$ kilos were brought in $4\frac{3}{4}$ hours approximately to a dead-roast in shallow iron trays, 7 × 23 inches ; 10 per cent. of finely pulverized charcoal was added to one of them, and the roast continued for 1 hour and 55 minutes, when all the carbon was consumed. The temperature at the beginning, 460° C., was slowly raised to the end, when it reached 767° C. The tabulated and plotted results show that during the first two hours the arsenic had been reduced to 0.8 and 0.9 per cent., and $2\frac{3}{4}$ hours later to 0.7 per cent., when charcoal was added to one lot, while at the end of the roast both samples retained 0.5-0.6 per cent. arsenic. Copper began to be converted into sulphate one hour after starting ; after 3 hours 5 per cent. was rendered soluble, the percentage of sulphate then diminished in one lot to 3 per cent. ; as soon as charcoal was added to the other lot (5 hours after starting) the sulphate was quickly decomposed, leaving only 0.2 per cent. soluble copper. The author believes that during the first period arsenic was eliminated mainly as arsenious oxide, and to some extent as disulphide. The arsenious oxide was formed by oxidation of arsenide and by the reduction of arsenic oxide by sulphur, sulphur dioxide, and ferrous oxide, having been separated from its base by sulphur trioxide present in excess. The arsenic remaining in the ore is believed to be in combination with copper as arsenate, in which form it is decomposed with great difficulty by a reducing roast.

Roasting Copper Ores at Keswick, California. BY TH. NEILSON. *Eng. Min. J.*, 68, 457.—The paper gives interesting data about roasting sulphide copper ores in heaps, stalls, and the Ropp and McDougal mechanical furnaces. The ore averages : Fe, 38 ; Cu, 8 ; Zn, 4 ; S, 46 ; SO₂, (?) and Al₂O₃, 3 per cent. ; Ag, 1.5 ozs. ; and Au, 0.03 ozs. per ton. Stalls 14 × 7 feet and 6 feet high, 170 in number, with a capacity of 6,000 tons of ore, were first used, but were replaced by heaps as the matting of the ore and the expense of discharging made the work too costly. The ore coming from the mine is charged into breakers with a grizzly with 3-inch spaces and a screen with $\frac{3}{4}$ -1 inch

openings, thus furnishing coarse, medium, and small-size ore, which is collected in separate bins. From these it is run on a trestle, with bents 15 feet apart, over the roast-yard, where the heaps 20 feet wide, 8 feet high, and, varying with the nature of the ground, from 500–1,500 feet long, are erected. Fines are spread to a depth of 6–12 inches, then follows the bed of dry free-burning light wood (pine, fir, cedar, manzanita) 6 inches square in four-foot lengths. Longitudinal flues 4 inches wide, and, at eight-foot intervals, similar cross flues, are left open to be fired with kindling. At their intersections chimneys $8\frac{1}{2}$ feet high are erected of old boards or of cord wood, and are filled with kindling. The fines are covered with cord-wood, and small wood is piled around the intersections of the flues. Coarse ore is now dumped onto the bed, and a wall six inches high of lump ore, or waste rock, is built outside of the wood, with arches over the flues. Coarse and medium ore follow, until the heap has nearly reached its normal height; it is followed by a cover of medium ore and then by one of fine ore about two inches in thickness. The heap being erected, the stringers (6×8 inches and 16 feet long), ties (4×4 inches), and rails (16–20 feet long), are removed to be used for another heap, while the poles (4–6 inches in diameter) are left, as the cost of recovering them is too great. The heap is fired by igniting one-half pint of coal oil poured into each of the chimneys. In one hour after starting the ore begins to burn. A heap burns about six months, reducing the sulphur to 12 per cent., of which 2 per cent. is present as sulphate. One cord of wood is sufficient for 120–150 tons of ore. When roasted, the ore is loaded by means of a $\frac{3}{4}$ -yard steam shovel into cars and goes to the blast-furnace. Drilling holes 10 feet apart under the heap and blasting loosens up the roasted ore and helps the work of the steam-shovel. Building the heaps as described costs 17.9 cents per ton; but this has been reduced to 9.31 cents by doing the screening at the mine. Discharging the heap by hand costs 23 cents, by steam shovel 4.92 cents per ton. The two McDougal furnaces, 15 and 18 feet in diameter, roast 20 and 35 tons of fines (under one-half inch size) in 24 hours at a cost of 12–15 cents per ton for labor, at \$1.85 per 10 hours. To the labor cost in the Ropp furnace, which is about the same as in the McDougal, 30 cents has to be added for cord-wood at \$3.00 per cord. Granulated matte is treated in both furnaces.

The Bretherton Blast-heater. BY S. E. BRETHERTON. *Eng. Min. J.*, 68, 689.—An illustrated description is given of an apparatus utilizing the waste heat of a movable forehearth for heating the blast.

A Study of the Elimination of Impurities from Copper Matte in the Reverberatory and the Converter. BY E. KELLER. *Trans. Am. Inst. Min. Eng.*, 28, 127-159; DISCUSSION, 816-840.—In bringing forward 60 per cent. copper matte to metallic copper in the reverberatory furnace, the first step is to crush the matte fine and to roast it in a hand reverberatory furnace. As in large-scale work the complete clean-up necessary to arrive at satisfactory data as to losses in roasting is not practicable, the author made some small-scale experiments in dead-roasting a matte of the following composition: Cu, 60.89; S, 23.22; Fe, 12.28; Fe_2O_3 , 0.34; Zn, 1.70; Pb, 0.568; Bi, 0.0501; Sb, 0.1010; As, 0.0481; Se, Te, 0.0101; Ag, 61.1 ozs.; Au, 0.20 ozs. He found by comparing raw and roasted matte that 5 per cent. of the arsenic and 15 per cent. of the antimony had been volatilized. By bringing the analyses of flue-dust and raw matte to the common basis of Cu = 100, and dividing the former by the latter, he found the relative elimination of the elements to be Cu, 1.00; Zn, 1.86; Pb, 1.88; Bi, 1.60; Sb, 8.15; As, 27.16; Se, Te, 2.80. Upon the assumption that the elimination of arsenic is proportional to that of sulphur, and that in actual roasting the sulphur content is reduced one-third, there will be found in the flue-dust the following percentages of the original quantities in the matte: Cu, 0.18; Zn, 0.34; Pb, 0.34; Bi, 0.29; Sb, 1.47; As, 5.00; Se, Te, 0.50. In smelting the roasted matte with silicious and calcic fluxes for bottoms, there are also formed regulus, slag, and incidentally some flue-dust. The author finds that arsenic concentrates three times as much as antimony or bismuth in the bottom, while lead, selenium, and tellurium concentrate in the regulus. The order in which the foreign constituents are eliminated from the regulus by slagging, volatilization, and draining into the bottom is the following: zinc, lead, bismuth, antimony, arsenic, selenium, tellurium, gold, and silver. In smelting the regulus and bottoms together in a reverberatory furnace for blister copper, the order of elimination of impurities by slagging is antimony, lead, selenium, tellurium, bismuth, and arsenic. In refining the blister copper, the impurities, slagged on the basis of 7 units slag to 100 copper, were Pb, 0.0678; Bi, 0.0009; Sb, 0.0115; As, 0.0020, while those remaining in the refined copper were Pb, 0.0093; Bi, 0.0320; Sb, 0.0651; As, 0.0586; and Se, Te, 0.0098. In refining converter copper, the order of slaggability was lead, antimony, arsenic, bismuth, and selenium-tellurium. After discussing the reduction of slags from the reverberatory process in the reverberatory furnace and of refinery slags in the blast-furnace, the author sums up the elimination of impurities in the total reverberatory process of copper smelting by comparing the values of the raw matte with those of the refined copper and

shows that the following percentages are eliminated by it : Pb, 99 ; Bi, 54 ; Sb, 50 ; As, 21 ; Se, Te, 60. In converting matte of a composition similar to that brought forward in the reverberatory furnace, the author shows that the following percentages of impurities are eliminated : Pb, 95-99.4 ; Bi, 94-96 ; Sb, 62-73 ; As, 73-91 ; Se, Te, 57.71 ; varying with the size of the converter and the extent to which the blowing was carried, a few minutes' overblowing being more efficient than hours of flapping in the reverberatory furnace. In the discussion of the paper the author tells of his laboratory experiments on the elimination of impurities by the James Direct Process. His results are unfavorable to it.

The Jackson System of Treating Ores. BY A. PHILLIPS. *Eng. Min. J.*, 68, 34 ; BY VAN ZWALUWENBURG, *Ibid.*, 68, 363-364.—A silver-gold ore is to be dead-roasted in a mechanical roaster with stationary hearth ; at the discharge it is to drop into a heated chamber, being at the same time supplied with salt and iron sulphide, which are to do the chloridizing. After passing through the chamber, the chloridized ore is to be cooled by passing through the open air, then fed into tanks, leached with brine and sodium hyposulphite, and the gold precipitated by some electrical means. Van Zwaluwenburg, who experimented at a large lixiviation plant in Mexico with the electrical precipitation, found it unsatisfactory as regards the deposition of silver and that, in addition, the hypo salt was decomposed.

The Alluvial Deposits of Western Australia. BY T. A. RICHARDS. *Trans. Am. Inst. Min. Eng.*, 28, 490-537.—This paper, mainly of a geological character, has a number of interesting illustrated descriptions of the separation of placer gold from sands by dry-blowing.

Water Required for Stamp-milling. BY G. W. RITER. *Eng. Min. J.*, 68, 278.—The author gives some data from his experience with ores from Eureka Hill, Tintic District, Utah, on the water required by the combination process, *i. e.* stamping, concentrating, and treating of settled tailings by pan amalgamation. The amounts required per ton of ore were $1\frac{3}{8}$ tons for crushing, concentrating, amalgamating, and retorting ; and, if the steam required for power, drying concentrates, heating pans, etc., be included, this figure was raised to nearly 2 tons.

Silver-Plating of Amalgam Plates for Gold Mills. BY A. J. CLARK. *School Mines Quart.*, 21, 48-56.—The paper is a description of a method used for replating the silver-plated amalgam plates (54 inches wide and 8-12 feet long) of the mills of the Homestake and Highland Mining Cos., at Lead City, S. D., after these

had shown a decrease in recovery of gold as soon as the original plating had begun to wear off. In order to have the silver adhere firmly to the copper plate, this must be absolutely clean. On a new plate, any scale rolled into the surface would cause the silver to form a rough deposit easily rubbed off in the daily collection of amalgam. A thin film of oxide or grease would give a somewhat uneven deposit, quickly washed off by the stream of pulp. On an old plate, after scraping off the remaining amalgam, the quicksilver has to be removed. Scraping by hand with acid treatment proved unsuccessful. Stripping (solution of any gold, silver, mercury, by the anode action of an electric current using iron plates as cathodes and potassium cyanide as electrolyte) proved successful as far as the cleaning was concerned, but it left the copper plate pitted, and while it took a good silver deposit, when used in the battery it did not work satisfactorily, the heavier sands settling in the hollows. Stripping had to be supplemented by a power scraper. A buff wheel with an emery-cutting surface was used, a small fan sucking off the cuttings and discharging them into a box filled with water. The scrapings were amalgamated in a Knox pan yielding a bullion with Au, 5-14, Ag, 14-23, and Cu, 72 per cent. Two men clean three plates in ten hours. The plates were painted twice on the reverse side with a solution of asphaltum in turpentine and then brought to a slightly inclined working table having cross strips of wood covered with rubber and a gutter to carry off the washings. The wood was painted with asphalt, and the whole placed under a hood connected with a fan. The scraped side of the plate may require scouring with sand or pumice stone to remove scale (the sand going to the mill), acid treatment (equal amounts of nitric and sulphuric acids with 1-5 per cent. of hydrochloric acid) to remove remaining oxides or mercury, a hot concentrated potash or soda wash to remove grease, a painting with potassium cyanide followed by one with cyanide of mercury, which tends to improve the adherence of the deposit. The depositing vat was 15½ feet long by 30 inches wide; it was made of 3-inch red-wood, heavily strapped, and lined with a layer of asphaltum by melting and pouring it in and ironing it out. The tanks were found to spread 2½ inches when filled, necessitating loosening the nuts of the straps. The depositing vat was set in a cement vat 3 feet deep to catch any leakage. There was a tank of pine wood, 10 × 5 × 5 feet, painted with asphalt into which the solution could be siphoned when it might require to be renovated. A plate was suspended by long hooks (passing through holes punched 2 feet apart along the edge) from a longitudinal bar held at the ends by a differential pulley and supported in the center by a lever. The electrolyte was a solution of silver chloride in potassium cyanide carryin

2.5 ozs of silver and one-half pound of potassium cyanide to the gallon. From 15-20 silver plates, 3 feet by 6 inches and one-fourth inch thick, were used as anodes for one copper cathode. With a single plate and an electrode distance of 16-17 inches, an electromotive force of 1.5 volts was ample. With a pair of plates hung back to back with anodes on either side and an electrode distance of 10-12 inches, 2-2.25 volts were necessary. The rate of deposition was 0.35-0.50 oz. per square foot per hour. A new solution did not work so well as one that had been used for some time. Every day the solution had to be stirred to correct a tendency of layering. After the deposition has been going on for 10 or 15 minutes the plate is drawn out and any imperfections corrected by scouring. The composition of the electrolyte has to be checked by determining the silver and free potassium cyanide.

De LaMar's Mercur Mines. BY H. L. J. WARREN. *Eng. Min. J.*, 68, 754-756; 787; 788.—The paper discusses the occurrence of the ore, the mining and the metallurgical treatment. There are two varieties of ore, oxidized and base; a third class called mixed ore, a talcose oxidized material, is recognized in the mill. The gangue consists of quartzite, limestone, shale, and clayey talcose material; it contains 20-30 per cent. SiO_2 . The oxidized ore is yellowish to brownish, the base ores carry 1-5 per cent. realgar and orpiment, cinnabar is occasionally found. The value in gold shows a range of \$2.00-\$60.00, and usually varies from \$3.00-\$12.00 per ton. The ore is passed through crushers, roughing rolls, and finishing rolls with intervening screens, leaves the last reduced to a limiting sieve with one-eighth inch holes. The oxidized ores are leached raw, the mixed ores are calcined in two Holthoff-Wethey mechanical furnaces (100 \times 12 feet), passing through them in six hours. Each treats 145 tons in 24 hours, and consumes 8 tons of coal. The object of calcining is to remove the combined water and thus render the ore readily leachable. The base ores with 2-5 per cent. sulphur and 0.95-2.50 per cent. arsenic are roasted in 4 Jacklin mechanical furnaces (120 \times 12 feet) passing through them in 8 hours. A furnace roasts 70 tons in 24 hours, consuming 7 tons of coal, and reduces the arsenic to 0.10-0.15 per cent. The oxidized, calcined, and roasted ores are collected together in a general charging bin whence they go to the leaching vats. There are 26 steel leaching tanks (50 \times 25 feet and 5 feet deep), each holding 250 tons of ore. On the bottom are spread 50 tons of cherty material, making a 10-inch filter bed. A tank is filled from side dump-cars by 3 men in 8 hours. First a strong 0.4 per cent. solution of cyanide is turned on from the bottom through 10 2-inch openings; it takes 8 hours to rise to the sur-

face, stands 16 hours, and then leaching by percolation is begun and continued for 24 hours. The first leaching is followed with a weak (0.3 per cent.) solution until the gold has been extracted, which takes two or three days, after which the wash-water is turned on. The rate of washing is one inch per hour, the weight of solution and wash-water used is about twice that of the ore. The leached ore is shoveled through openings in the bottom into cars by ten men in four hours. Solutions and wash-water flow into two collecting tanks (20 feet in diameter and 12 feet deep), whence they are pumped into three precipitating tanks (16 feet in diameter and 8 feet deep). The gold is precipitated by means of zinc dust. While the solution flows into a tank it is kept stirred by compressed air passing at a pressure of 20 pounds through a one-half inch pipe. When a tank is filled with its first solution, 30 pounds of zinc dust are given, with the second charge 20 pounds, and with the third and the rest 10 pounds, 15 pounds being required on the average for a full charge of liquor, which weighs 30 tons. When the precipitation is finished, the solution is allowed to settle and is passed through ten filter-presses (Stillwell-Bierce and Smith-Vaile pattern, 24 inches square) into a sump 24 feet in diameter and 8 feet deep. The solution before precipitation contains \$3.00 gold per ton, and after precipitation \$0.20; the zinc consumption is $1\frac{1}{3}$ pounds per ounce of gold. Before bringing the low solution to the normal standard by the addition of fresh potassium cyanide, one pound of caustic soda is added to a ton of solution so as to preserve its alkaline character. At the monthly clean-up, the precipitate from the vats and filter-presses is dried and heated in shallow pans in a muffle furnace to oxidize the zinc, and then crushed to pass a one-fourth inch screen. It contains about 20 per cent. gold; there is always present 1 part silver to 100 parts of gold. The crushed material is treated with sulphuric and nitric acids and brought up to 60 per cent. gold. It is now filtered in a press, dried in a muffle, broken to one-half inch size, mixed with flux (1 potash, 2 soda, and 2 borax), and melted down in a graphite crucible. The gold is 950 fine.

Mill Practice of the Utica Mills, Calaveras County, California.

By W. J. LORING.—*Trans. Am. Inst. Min. Eng.*, 28, 553-565. —The paper gives full practical details of the manner of working at the three mills containing 120 stamps in all. Of special interest is the use of shoes of manganese-steel, 8.5 inches in diameter of face and 10 inches high, which last on the average 296 days, weighing 177 pounds when new and 28 pounds when used up so that they have to be exchanged. Manganese-steel has also done better work in the crushers than any other kind of iron. A stamp weighs 835 pounds, drops 7-8

inches 100 times a minute, crushes per day 4.8 tons through a fine, round-punched screen (corresponding to 30-mesh), requires per battery of five stamps 8.5 gallons of water per minute, and 2.5 gallons per minute for the two concentrators belonging to it. The consumption of quicksilver per ton of ore is 0.076 ounce. Concentrates from the vanners and the Gates canvas-plant are chlorinated and the slimes finally treated with potassium cyanide. The cost of milling, exclusive of power, is 13.8 cents per ton. For further details the reader must be referred to the original paper.

Cyaniding Slimy Ores and Tailings. BY M. W. ALDERSON. *Min. Sci. Press*, 78, 584, 612, 636, 665; 79, 4.—The author discusses first the early attempts at cyaniding slimes in Montana. He then takes up the treatment by agitation and illustrates the working of a vertical agitator with steel propeller blades, rotating at the rate of 16 revolutions per minute in a vat 16 feet in diameter and 5 feet deep, holding 20 tons sands or 12 tons of slimes. With the ore are charged 12 pounds of lime to neutralize any active acidity and to aid in settling the slime. For a ton of ore there is required usually one ton of solvent, rarely 1.5–2 tons. The agitation is continued until a sample of solution shows the enrichment it ought to have, this being ascertained by preliminary tests. When agitation has been stopped, the charge is allowed to settle. After 1–2 hours, decantation can be begun by removing the plugs one after another from the 3-inch auger-holes bored in the sides. Decantation is continued until there remains not more than one-half inch of clear solution on top of the slime. The decantation of the strong solution is followed by two washes of 2 or 3 tons of water per ton of ore. The whole operation takes about 30 hours. The tailings are discharged at the bottom into a launder. The gold solution is collected in a vat with floating drain and passes through the zinc boxes. Trouble is here encountered on account of the very weak solutions, the original solution being greatly diluted by the decantations. The author overcame the difficulties by periodically allowing the zinc shavings in the extractor to stand in contact with a solution very much stronger than the normal (one-half pound cyanide to 1 ton solution) in order to remove incrustations formed by the weak normal solution. He did this by placing, every 6 hours, 1.5 pounds potassium cyanide in the head compartment. The extractor, 3 feet wide by 12 feet long has 7 compartments, the first four are 18 × 18 inches, the last three 12 × 18 inches, and treats 30 tons solution in 24 hours. Most of the cyanide works send their precipitated gold to a United States assay office to be refined. The author, after experimenting in vain with sulphuric acid and hydrochloric acid,

tried nitric acid, which worked satisfactorily. The dissolved silver was precipitated by salt and the chloride decomposed by fusion, etc.

Cyaniding at Gilt Edge, Montana. BY M. W. ALDERSON. *Min. Sci. Press*, 79, 408.—The gangue of the ore is porphyry and altered limestone averaging 20 per cent. SiO_2 . The porphyritic ore assays \$3–\$10 and the limestone as high as \$300 per ton, average ore assay \$7.00. Everything down to \$3.00 goes to the mill, which has a capacity of 160 tons per day. The ore reduced to one-fourth inch size is charged into six steel vats 28 feet in diameter and 6 feet deep, each holding 70 tons of ore. It is first treated with a solution containing 4 per cent. cyanide (one-quarter ton solution to 1 ton ore), which remains 8 hours in contact with it. This is followed by the leaching solution, 0.24–0.25 per cent. cyanide, which percolates in 52 hours, and the leaching solution by two wash-waters of 6.5 tons each. The ore when charged contains 4 per cent. water, when drained, 13 per cent. In the leaching room there are besides the ore vats, two solution tanks (12 feet in diameter and 4 feet in height), one sump tank (14 × 4 feet) and one water tank (14 × 12 feet). In the precipitating room are six zinc boxes, the precipitated gold is treated with sulphuric acid, the refined bullion is 900–1000 to 950–1000 fine. The tailings average \$1.00. The cost of treatment in July, 1899, was \$1.32 per ton, a total of 2800 tons being handled. There was consumed about one-eighth pound potassium cyanide per ton of ore.

The Pneumatic Cyanide Process. BY J. WEBB. *Eng. Min. J.*, 68, 4.—The idea of the process is to stir with compressed air a warmed cyanide solution, thus permitting a quick treatment of slimes or ores crushed very finely, and a degree of aeration otherwise not attainable. The process is still in the experimental stage.

The Pneumatic Cyanide Process. BY A. DEL MAR. *Eng. Min. J.*, 68, 94.—The author criticizes the process on account of the greatly increased consumption of cyanide which must follow from the continuous air-stirring of the warmed solution.

Notes on Tuyeres in the Iron Blast-furnace. BY J. M. HARTMAN. *Trans. Am. Inst. Min. Eng.*, 28, 666–673, 902–907. BY B. F. FACKENTHAL. *Ibid.*, 28, 673–678, 858–872.

Note on the Use of the Tri-axial Diagram and Triangular Pyramid for Graphical Illustration. BY H. M. HOWE. *Trans. Am. Inst. Min. Eng.*, 28, 346–355, 894–901.—In representing graphically the properties of slags the tri-axial diagram

serves an excellent purpose. To illustrate it, the author has plotted the total heats of solidification of an extended series of lime-alumina-silicates examined by Prof. Åkerman. The lines joining the points of equal total heat of solidification, called "isocals," tell a clear story of the relation between composition and total heat of solidification. The author further outlines the use of a triangular pyramid for the graphical representation of four variables.

Analysis of Blast-furnace Gas while Blowing In. BY R. H. SWEETSER. *Trans. Am. Inst. Min. Eng.* **28**, 608-613.—The paper is a record of analyses of the gas made during the blowing-in of the furnace "C" of the Maryland Steel Co., at Sparrow's Point, Md., the time covered being from 12.26 P.M. of one day to 2.45 P.M. on the following day. With the analyses are tabulated the revolutions of the engine, the pressure and the temperature of the blast, and the height of the stock. These figures, as well as the conditions of normal work, are graphically represented to facilitate comparison.

Note on the Forms Assumed by the Charge in the Blast-furnace, as Affected by Various Methods of Feeding. BY F. FIRMSTONE. *Trans. Am. Inst. Min. Eng.*, **28**, 370-395.—This is an extended illustrated paper on the effects of different methods of feeding on the distribution of ore, flux, and fuel in the blast-furnace, and on the working of the furnace itself.

Note on Slips and Explosions in the Blast-furnace. BY F. B. RICHARDS. *Trans. Am. Inst. Min. Eng.*, **28**, 604-608, 911-919.—Two illustrations accompanying the note represent the Claire furnace of Sharpsville, Pa., one while in normal condition and the other 5 seconds after an explosion or slip had taken place. The second picture shows the tremendous force of the accidents caused by the use of fine Menominee and Mesabi ores. The furnace, 75 feet high, with a 16-foot bosh, a 10-foot 6-inch hearth, and 13 tuyeres, was working an ore mixture containing 37.5 per cent Mesabi ore, 25 per cent. of which would pass through a 100-mesh sieve, the balance coming from the Menominee and Marquette ranges.

The Manufacture of Sulphur-free Mineral Wool. BY A. D. ELBERS. *Eng. Min. J.*, **68**, 248-249.—The paper gives a review of the manufacture of mineral wool and discusses the process invented by the author for freeing it from calcium sulphide, a substance which has prevented mineral wool from being used as much as it deserves. The process consists in remelting iron blast-furnace slag with moderate quantities of gypsum or other alkaline earth sulphates, when the reaction $3\text{CaSO}_4 +$

$\text{Ca}(\text{Mg}, \text{Fe})\text{S} = 3\text{CaO} + \text{Ca}(\text{Mg}, \text{Fe})\text{O} + 4\text{SO}_2$, takes place, and the sulphur dioxide is carried away by the gases, the atmosphere in the cupola being sufficiently oxidizing to prevent its reduction. Some of the gypsum charged cannot but be superficially reduced to calcium sulphide, and has to be reoxidized by the remaining sulphate; thus more gypsum is required than is called for by the formula.

The Utilization of Blast-furnace Slag. BY A. D. ELBERS. *Eng. Min. J.*, 67, 649-650, 708.—The author discusses the possible uses to which iron blast-furnace slags have been and can be put, and then takes up their desulphurization.

The Kytchtym Medal. BY P. FRAZER. *Trans. Am. Inst. Min. Eng.*, 28, 613-617, 848-854.

Blast-furnace and Cupola Practice. BY E. S. COOK. *J. Am. Foundrymen's Assoc.*, 6, 295-313; *Iron Age*, 63, May 11, 1899.—The paper compares in a general way the work in the blast-furnace and the foundry cupola. The following points are not generally known: 1. Iron run into chilled molds contains more graphitic carbon than when run into sand beds. Thus cast No. 81, of the Warwick furnace, showed in chilled molds: graphitic C, 2.87; combined C, 0.48; total C, 3.35; Mn, 0.42; P, 0.36; S, 0.017; Si, 1.50; and in sand molds graphitic C, 2.57; combined C, 0.42; total C, 2.99; Mn, 0.41; P, 0.36; S, 0.010; Si, 1.52, the reason being that the iron molds are dry and frequently warm. 2. In casting by a machine, the cold iron molds will have a chilling effect on the iron, and disturbing the crystallization, will interfere with the usual grading by fracture, hence a new method of grading (by composition) becomes necessary. The leading components being silicon and sulphur, the grading ought to be as follows:

| | No. 1. | No. 2x. | No. 2, soft. | No. 2, plain. | No. 2, strong. | No. 2 foundry. |
|-------------|---------------|---------------|---------------|---------------|----------------|----------------|
| Silicon.... | 2.50-3.00 | 2.00-2.50 | 2.50-3.00 | 2.00-2.50 | 1.50-2.00 | 1.50-2.50 |
| Sulphur .. | 0.02 and less | 0.02 and less | 0.05 and less | 0.05 and less | 0.05 and less | over 0.05 |

3. The furnaceman as well as the foundryman finds a guide for the quality of the pig in casting chill-cup test-pieces, as iron of certain grades will not take a chill. At Warwick, for example, iron low in manganese with 1.5 per cent. Si and that with 0.03 per cent. S will not take a chill; with 1.00 per cent. Si and 0.02 per cent. S there may be a slight chill; with 0.08 per cent. S the chill will be one-half inch deep. Pig with 2-3 per cent. Si and 0.05 per cent. S will not chill; with 0.10 per cent. S a chill will be seen in spite of the high percentage of silicon. The chill produced by sulphur is very different from that resulting from a lack of silicon.

Modern Cupola Practice with Special Reference to the Discussion of the Physics of Cast-iron. BY B. S. SUMMERS. *Trans. Am. Inst. Min. Eng.*, 28, 396-413, 769-796, 884-893.—In foundry practice it is held by many that the silicon is the governing element; the author disagrees with this opinion, believing that graphitic carbon controls the value of a casting. While the most prominent function of silicon in foundry iron is that it promotes the formation of graphitic carbon, it also lowers the saturation of iron for carbon. Machinery castings of close texture should contain between 1.50 and 2.00 per cent. silicon and may reach 2.25 per cent.; light hardware may contain as much as 3 per cent. silicon; with more than 3 per cent. silicon, castings become brittle; for ordinary castings sulphur, which interferes with some of the good effects of silicon, should not exceed 0.10 per cent., and had best be kept below 0.08 per cent. While pig-iron rarely contains a harmful amount of sulphur, it is often introduced into the mixture through ferrosilicons, some well-known brands of which the author found to contain 0.17-0.18 per cent. The limit of phosphorus for most cases is about 1.00 per cent; where great strength is required the percentage ought to be much lower. As to manganese, 0.80 per cent. will hardly be noticed and it may reach 1.00 per cent. On account of the property of manganese to counteract the formation of blow-holes or the iron becoming spongy, the use of manganese is desired so long as it does not harden the iron. As to the forms of carbon, the author is inclined to attribute a considerable importance to amorphous temper carbon, and believes that the closer and denser fracture of charcoal-iron over coke-iron may be attributed to it. The reviewer would point out that the microphotographs of Glinz, published in *Stahl und Eisen*, 1899, page 1062, show that this difference in fracture is due rather to the more uniform distribution of graphite than to the presence of temper carbon. As to the relation of silicon and graphitic carbon, the author shows by analysis that an increase of silicon does not have a corresponding increase in the graphitic carbon; in fact, records for months in works show that silicon varying between two and three per cent. has much less effect on the separation of carbon as graphite than is usually supposed. The effect of silicon seems to be governed more by the temperature at which it is allowed to act. The higher the coke consumption up to a certain limit, and with it the larger the volume of blast, the greater will be the total carbon and the percentage of graphite. Rusty scrap-iron, especially if much corroded, has a tendency to make iron spongy.

The Manufacture of Car Wheels. BY G. R. HENDERSON. *The Foundry*, 15, 48-53.—The paper discusses the control by

mechanical tests and chemical analyses of the materials used in the manufacture of the finished product. Bars of wheel-iron 2 inches square by 24 inches should stand, with supports $21\frac{1}{2}$ inches apart, a center load of 12,000-14,000 pounds before breaking, showing a deflection of 0.2 inch at center; in testing, the amount of chill, the shrinkage, and the fracture should be noted. Car wheels should show the following limits in chemical composition: graphitic C, 2.75-3.00; combined C, 0.50-0.75; Si, 0.50-0.70; Mn, 0.50-0.75; S, 0.05-0.07; and P, 0.35-0.45 per cent.

The Malleable Iron Industry: Its Development in the United States. BY G. C. DAVIS. *J. Am. Foundrymen's Assoc.*, 6, 59-67.—This paper is a historical one. In 1853 there were five foundries in this country making malleable castings. At present there are ninety with a capacity varying from one to eighty tons per day.

The Basic Furnace for Malleable Iron. BY E. C. WHEELER. *The Foundry*, 14, 247-250.—The author advocates the use of an 8-10 ton basic open-hearth furnace for foundries having a tonnage of 60-100 tons per day. A heat would be tapped into a ladle attached to an overhead traveling crane, and its contents poured into small ladles when the moulder's floor had been reached. While pouring, the melting furnace would be recharged and the fusion well under way before the pouring was finished.

Suggested Improvements in the Manufacture of Bar-iron. BY S. PETERS. *Proc. Eng. Soc. Western Pa.*, 15, 222-230; *Iron Age*, 63, May 11, 1899, 14-15.—In puddling gray-forge iron, 500-600 (sometimes 1,000) pounds of iron ore are required per ton of muck bar, exclusive of tap-cinder and squeezer-cinder. This forms a very large amount of slag which is liable to retard somewhat the process; a lack of cinder is perhaps still more harmful, as the impurities will not be sufficiently diluted in the cinder, and will with the slag reenter the puddled ball; further, the refining will be retarded, and hence the welding of the granules. The improvement suggested is to melt down the pig in a cupola, transfer to a Bessemer converter, and desiliconize and mostly decarbonize (Si, 0.05; C, 0.5; P, 0.5; S, 0.05), transfer the liquid metal to a rotary reverberatory furnace lined with bauxite or magnesite, remove with small addition of raw ore, carbon and phosphorus making as acid a slag as is permissible (say 15 per cent. SiO_2). By delivering to the balling turnace metal in definite quality and of definite composition, and by regulating the quality and quantity of the slag, more uniform

results will be obtained than at present ; moreover, more work can be done on a large scale.

The Relations between the Chemical Constitution and the Physical Character of Steel. BY W. R. WEBSTER. *Trans. Am. Inst. Min. Eng.* **28**, 618-665, 876-883.—The author gives a review of the subject accompanied by a general discussion and tables, to which the reader is referred.

Notes on the Bertrand-Thiel Process. BY J. HARTSHORNE. *Trans. Am. Inst. Min. Eng.*, **28**, 254-264.—The paper is a report on the progress made with this process since 1896. It gives the titles of the papers published on the process, discusses them briefly, and summarizes the results obtained at Kladno, using pig and scrap, cold pig iron alone, and molten metal from the blast-furnace.

An Explanation of the Rapidity of the Bertrand-Thiel Process. BY H. M. HOWE. *Eng. Min. J.*, **68**, 276-277.—In this process, which is a modification of the basic open-hearth process, cast-iron is melted down in one furnace and the elimination of phosphorus and silicon started ; scrap and ore are melted down at the same time in a second furnace situated at a lower level, where the iron becomes somewhat oxidized ; now the metal from the upper is tapped into the lower furnace and its slag diverted during the flow. The two charges react quickly, and the carbon and phosphorus are rapidly removed. By the removal of silicon and the partial elimination of phosphorus in the upper furnace, with a slag that is not very basic relatively little lime has to be added with the result that a smaller quantity of slag per unit of iron is produced than in the regular practice, which aims to remove the whole of the phosphorus in one operation. This smaller amount of slag leaves more room in the furnace for the metal charge. The partly treated metal charge free from slag meets, in the lower furnace, iron oxide containing very little slag, hence the reaction is vigorous and the amount of slag formed small, which again leaves more room for the metal. The higher temperature over that in the ordinary process is explained by the higher initial temperature of the substances brought together. The frothing of the charge in the lower furnace during the boiling period is less, on account of the smaller amount of slag and its higher temperature.

ASSAYING.

H. O. HOFMAN, REVIEWER.

Experiments in Sampling Silver-Lead Bullion. BY G. M. ROBERTS. *Trans. Am. Inst. Min. Eng.*, **28**, 413-427.—The

conclusions arrived at by the author as a result of his experiments are that dip-samples and saw-samples give the only true results, and that the chip-samples from top and bottom are unsatisfactory. For casting a bar from a set of samples, the author advocates melting down quickly in a red-hot crucible. He found that no loss by volatilization took place in melting, and that the loss by absorption in cupelling 400-oz. bullion was not more than 0.06 oz. per ton.

The Calkins Cupel Machines. BY R. P. ROTHWELL. *Eng. Min. J.*, 68, 639.—A compact apparatus is described for compressing cupels by a compound hand-lever with die and two disks serving as mould and support.

Scorification and Cupellation without Muffle. A New Furnace and Method for Gold and Silver Assays. BY G. A. KOENIG. *Trans. Am. Inst. Min. Eng.*, 28, 271-288.—The author describes and illustrates a furnace constructed by him combining the crucible and muffle furnace. It consists of an oblong brick chamber closed at the bottom by a tile and at the top by a hinged roof. The heat is supplied at the back by a gas or gas-oil flame, which heats the six Battersea F. crucibles that the furnace holds. For scorification- and cupellation-assays a narrow fire-clay tile is placed longitudinally in the furnace to carry the scorifiers or cupels. The gas flames travel underneath the tile and rise at the front where there are blowpipes to furnish the air necessary for oxidation. The author finds that his cupellation results compare favorably with those obtained in the muffle as to accuracy, and have the advantage of taking from one-fourth to one-sixth the time required by the ordinary method, and of making the work easier for the assayer, who has not to suffer from any heat whatever. By this new method of cupelling, the lead is little absorbed by the bone-ash of the cupel, which does not become very hot, but is rather volatilized.

Proof Gold and Silver. BY C. WHITEHEAD. *Eng. Min. J.*, 68, 785-786.—The method for proof gold consists in rolling out the gold to a ribbon, treating in a flask with hydrochloric acid, to which nitric acid is added until the solution is completed, evaporating to dryness, with the addition of hydrochloric acid if necessary, to remove all nitric acid, adding a few cubic centimeters of hydrobromic acid, diluting with water to 1 oz. Au in 1 gal., agitating, allowing to settle, siphoning off the clear gold solution through a double filter, without disturbing the precipitate or washing the filter, and precipitating the gold with sulphurous acid. The gold is redissolved, etc., but now precipitated with a warm solution of concentrated oxalic acid solution and the precipitations are repeated and the precipitate washed

with water, nitric acid, water, hydrochloric acid, and water. The pure gold is melted with one-fifth of its weight of 3 parts of fused borax and 1 part of niter in a porcelain crucible and cast into a chalked mould. The bar is cleaned by brushing and heating with hydrochloric acid, dried, cut up, rolled, the ribbons are boiled in acid, washed, and heated to redness in a muffle. The method for silver consists in wrapping fine (999) silver in filter-paper and enclosing it in a cotton bag and then electrolyzing with silver nitrate containing 1 per cent. free nitric acid as electrolyte. Pure silver crystals are deposited on the cathode. They are washed, dried, melted with the gold flux, the bar is remelted, but without any flux, and the melted silver stirred with wood to remove occluded oxygen. It is poured into a chalked mould, cleaned by brushing, and with dilute sulphuric acid, and washed, dried, and rolled out ready for use.

Assaying Telluride Ore for Gold. BY R. W. LODGE. *Tech. Quart.*, 12, 171-174.—The author compares the scorification and the crucible methods for the assay of telluride gold ores, and concludes that satisfactory results can be obtained with either, as long as the samples are ground sufficiently fine, with rich ores through a sieve of not less than 140 meshes to the linear inch.

A New Assay for Mercury. BY R. E. CHISM. *Trans. Am. Inst. Min. Eng.*, 28, 444-452.—The method described is a modification of the one devised by Eschka. A Battersea gold-annealing cup, size C, fitted into a circular opening of a piece of tin plate so as to protrude about 1 cm., holds the charge of $\frac{1}{2}$ to 1 gram of ore mixed with 5 grams of prepared iron filings. It is heated with a spirit lamp having a wick 6 mm. in diameter, drawn out to produce a flame 4 to 5 cm. high. The volatilized mercury is condensed on a piece of silver foil, about 5 cm. square, which is kept cool by a flat silver or copper dish $5\frac{1}{2}$ to $6\frac{1}{2}$ cm. in diameter, and somewhat over 1 cm. high, holding about 20 cc. of water. The time required for an assay is ten to fifteen minutes. After weighing the silver foil, it is placed again on the crucible, which is heated for ten minutes more to see if there is any gain in weight. The results are accurate.

[CONTRIBUTION FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.]

REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. VI. No. 4.

ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

INORGANIC CHEMISTRY.

HENRY FAY, REVIEWER.

Some Double Halides of Cadmium with the Methylamines and Tetramethylammonium. BY C. D. RAGLAND. *Am. Chem. J.*, 22, 417-434.—These double salts were prepared by bringing together concentrated solutions of the separate salts. The volumes of the solutions were so taken as to vary the molecular proportions, making a series in which the salts varied from a 1 : 4 to a 4 : 1 mixture. When solutions of methylamine hydrochloride and cadmium chloride were mixed in varying proportions, only one salt could be obtained, that of the 2 : 1 type. With cadmium chloride in large excess there was some evidence of another salt, but it could not be obtained in pure condition. Methylamine hydrobromide and cadmium bromide form two salts representing the 1 : 1 and the 2 : 1 types. It was impossible to prepare the double iodides. Dimethylamine hydrochloride and cadmium chloride form three salts in which the proportions of the former to the latter are 1 : 1, 1 : 2, and 3 : 2. The double bromides likewise form three salts, but of the types 1 : 1, 2 : 1, and 1 : 4. Dimethylamine iodide and cadmium iodide form one salt in which the ratio is 1 : 1. Trimethylamine hydrochloride and the hydrobromide with the corresponding cadmium salts each give two double salts of the same types, 1 : 1 and 3 : 2. Trimethylamine iodide and cadmium iodide form the 1 : 1 and 2 : 1 salts. Tetramethylammonium chloride forms with cadmium chloride the one salt in which the proportions are 1 : 1. The 1 : 1 and 2 : 1 salts are formed with tetramethylammonium bro-

amide and cadmium bromide and with tetramethylammonium iodide and cadmium iodide. The 3 : 2, 1 : 2, and 1 : 4 salts have no analogues among the double halides of the alkali metals and ammonium with cadmium.

Some Double Halides of Tin with the Aliphatic Amines and with Tetramethylammonium. BY C. G. COOK. *Am. Chem. J.*, 22, 435-446.—These salts show a marked regularity throughout the series. With the single exception of the triethylamine chlorstannate, which is a 3 : 1 salt of the composition $[(C_2H_5)_3NH]_3SnCl_6$, all of the series are 1 : 1 or 2 : 1 salts. The double salts formed by bringing together the chlorides of methyl, dimethyl, trimethyl, ethyl, triethyl, and tetramethylammonium with stannous chloride are all of the 1 : 1 type. Stannous bromide forms the 1 : 1 type with the bromides of methyl-, dimethyl-, and ethylamine. All of the above amine salts give with the corresponding halogen salt of stannic tin, the 2 : 1 type of salt. In addition, trimethylamine and triethylamine bromstannate are described. Both are 2 : 1 salts. When stannous chloride was mixed with triethylamine hydrochloride oxidation always took place, so that from such solutions it was possible to isolate only the chlorstannate.

Notes on the Double Halides of Tin with the Organic Bases. BY GEORGE M. RICHARDSON AND MAXWELL ADAMS. *Am. Chem. J.*, 22, 446-449.—The authors describe a few additional salts of this series which were not found by Slagle (*this Rev.*, 5, 29). Tetraniline chlorstannate was obtained by concentration of solutions of aniline hydrochloride and stannous chloride, after the first crop of crystals, dianiline chlorstannite, had been removed. Dimethylaniline chlorstannite, $C_6H_5NH(CH_3)_2 \cdot SnCl_3 \cdot \frac{1}{2}H_2O$, was prepared in the same way, and is entirely analogous to the corresponding toluidine compounds described by Slagle. Aniline bromstannite, $C_6H_5NH_2 \cdot SnBr_3$, dianiline bromstannate, $(C_6H_5NH_2)_2 \cdot SnBr_6$, and tetraniline bromstannate,



were prepared and described.

On the Effect of Various Solvents on the Allotropic Change of Mercuric Iodide. BY J. H. KASTLE AND MARY E. CLARK. *Am. Chem. J.*, 22, 473-484.—Kastle had previously observed that the yellow modification of mercuric iodide could be obtained by dissolving the red modification in boiling amyl alcohol and allowing the solution to cool. The authors have now studied the solutions of mercuric iodide in a large number of organic solvents of different boiling-points. With the exception of the solutions in the alkyl halides, which were colored pink due to a

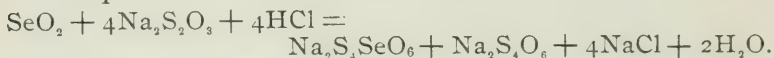
small amount of double decomposition, all solvents tried were colored yellow. From these solutions the yellow modification crystallized, but on standing it gradually passes back into the red form. When an excess of red mercuric iodide is used in a solvent some of the solid is changed to the yellow. The yellow crystals which come out of solution are soon converted into red on coming in contact with the red variety. Low-boiling liquids apparently produce the conversion as well as high-boiling liquids. Mercuric iodide, like phosphorus, appears capable of existing in solution and in the form of vapor only in the condition of the yellow compound, and this is either identical with or a polymer of the solid yellow mercuric iodide.

The Preparation of Pure Tellurium. By JAMES F. NORRIS, HENRY FAY, AND D. W. EDGERLY. *Am. Chem. J.*, **23**, 105-119.—This paper is a preliminary study of methods for the preparation of a pure material which might be used for a determination of the atomic weight of tellurium. The tellurium was obtained from a residue produced in the electrolytic refining of copper. The residue was extracted with strong hydrochloric acid, and from this solution the tellurium was precipitated with acid sodium sulphite. Much of the selenium which is invariably present may be removed by filtering off the first precipitate produced by acid sodium sulphite. Further addition of sulphite throws out the tellurium with traces of other elements which may be present. To purify the crude metal it was added to warm, dilute nitric acid (sp. gr. 1.25), and the resulting solution evaporated to dryness, in order to insure complete removal of silica. The basic nitrate of tellurium was converted into oxide, extracted with hydrochloric acid, and from this solution it was again precipitated as a metal, dissolved in dilute nitric acid, and the basic nitrate, $\text{Te}_2\text{O}_3(\text{OH})\text{NO}_3$, obtained by crystallization. Two crystallizations rendered it perfectly pure. It was shown to be free from selenium dioxide by a delicate reaction based on the fact that selenium dioxide liberates iodine while the tellurium is converted into tetraiodide. Other impurities were tested for but not found present. The basic nitrate of tellurium crystallizes from strong nitric acid solution in well-developed orthorhombic prisms, which are entirely stable in the air. Dilute nitric acid decomposes the basic nitrate of tellurium with formation of the dioxide. The basic nitrate does not begin to decompose until heated to 170° . At 190° the oxides of nitrogen begin to be evolved. When heated slowly to a higher temperature, decomposition continues until it is converted into the oxide. By rapid fusion of the oxide, after previous slow heating, very accurate determinations could be made. To test the homogeneity of tellurium a fractionation, involving 215 crystalliza-

tions, of the double bromide of tellurium and potassium was carried out. This salt was prepared from carefully purified materials. There were no indications, during the fractionation, of any change in the salt, so that it was necessary to make an analysis of the end fractions. To this end the basic nitrate, made from the double tellurium bromide, was decomposed in a platinum crucible arranged with several disks over which the escaping gases were forced to pass in order to avoid mechanical loss. The decomposition was accomplished slowly by heating at various periods to a gradually increasing temperature. The oxide was finally fused quickly in the oxidizing flame of a Bunsen burner. The analysis of the nitrate prepared from the tellurium from the fraction which would contain the most soluble portion, gave 83.45 and 83.44 per cent. of TeO_2 ; from the least soluble portion, 83.48 and 83.49 per cent. TeO_2 . The fractionation, therefore, did not effect any decomposition of the tellurium which could be detected by a method capable of giving results accurate to 0.4 of a unit in the atomic weight.

The Reduction of Selenium Dioxide by Sodium Thiosulphate.

BY JAMES F. NORRIS AND HENRY FAY. *Am. Chem. J.*, 23, 119-125.—In a previous paper (*this Rev.*, 4, 31) a volumetric method for the determination of selenium dioxide was described. It was based on the reaction between selenium dioxide and sodium thiosulphate, four molecules of the latter reacting with one of the former. It was not known at the time what was the nature of the reaction, but the reaction is now shown to proceed according to the equation:



The formation of sodium selenopentathionate, similar to potassium pentathionate, seemed probable since no selenium was precipitated in the reduction. A solution prepared by mixing the constituents in the proportions represented in the equation, gave all the characteristic reactions of the pentathionates with the exception that selenium was precipitated instead of sulphur. Attempts to isolate the sodium selenopentathionate were not successful. Tellurium seems to form an analogous compound. In reply to a criticism by Mr. Norton (*this Rev.*, 5, 89) the authors have again studied the conditions under which the volumetric method can be most accurately carried out. It was found that Mr. Norton had confused *excess* of acid with *amount*. The amount, however, which was recommended by the authors is more than is absolutely necessary, although it does not interfere with the accuracy of the method. It is shown that low temperature and the presence of acid have great influence on the delicacy of the starch reaction.

The Double Halides of Antimony with Aniline and the Toluidines. BY HOWARD H. HIGBEE. *Am. Chem. J.*, 23, 150-173.

—Mixtures of the halide of the base were brought together with the antimony halide, each constituent having been previously dissolved in the corresponding halogen acid. From the various mixtures of aniline hydrochloride and antimony trichloride, trianiline chlorantimonite, $(\text{C}_6\text{H}_5\cdot\text{NH}_2\cdot\text{HCl})_3\cdot\text{SbCl}_3\cdot\text{H}_2\text{O}$, crystallized from most of the mixtures; from the mixture in which the proportion of base to antimony was 1 : 2, monaniline chlorantimonite, $\text{C}_6\text{H}_5\cdot\text{NH}_2\cdot\text{HCl}\cdot\text{SbCl}_3\cdot\text{H}_2\text{O}$, was obtained. From *o*-toluidine hydrochloride and antimony trichloride only one salt was isolated, di-*o*-toluidine chlorantimonite, $(\text{C}_6\text{H}_4\cdot\text{CH}_3\cdot\text{NH}_2\cdot\text{HCl})_2\cdot\text{SbCl}_3$; *m*-toluidine hydrochloride gave two salts, tri-*m*-toluidine chlorantimonite, $(\text{C}_6\text{H}_4\cdot\text{CH}_3\cdot\text{NH}_2\cdot\text{HCl})_3\cdot\text{SbCl}_3$, and di-*m*-toluidine chlorantimonite, $(\text{C}_6\text{H}_4\cdot\text{CH}_3\cdot\text{NH}_2\cdot\text{HCl})_2\cdot\text{SbCl}_3\cdot\text{H}_2\text{O}$; *p*-toluidine hydrochloride likewise gave two salts, di-*p*-toluidine chlorantimonite, $(\text{C}_6\text{H}_4\cdot\text{CH}_3\cdot\text{NH}_2\cdot\text{HCl})_2\cdot\text{SbCl}_3\cdot\frac{1}{2}\text{H}_2\text{O}$, and tri-*p*-toluidine chlorantimonite, $(\text{C}_6\text{H}_4\cdot\text{CH}_3\cdot\text{NH}_2\cdot\text{HCl})_3\cdot\text{SbCl}_3\cdot\text{H}_2\text{O}$. Aniline hydrobromide and antimony tribromide yielded the two salts $(\text{C}_6\text{H}_5\cdot\text{CH}_3\cdot\text{NH}_2\cdot\text{HBr})_2\cdot\text{SbBr}_3$ and $(\text{C}_6\text{H}_5\cdot\text{CH}_3\cdot\text{NH}_2\cdot\text{HBr})_4\cdot\text{SbBr}_3\cdot\text{H}_2\text{O}$. One salt, tri-*o*-toluidine bromantimonite $(\text{C}_6\text{H}_4\cdot\text{CH}_3\cdot\text{NH}_2\cdot\text{HBr})_3\cdot\text{SbBr}_3$ was obtained from *o*-toluidine hydrobromide and antimony tribromide; *m*-toluidine hydrobromide also gave but one salt in which the ratio of base to antimony was 2 : 1; *p*-toluidine hydrobromide gave three salts in which the ratios of base to antimony were respectively 2 : 1, 3 : 1, and 4 : 1. In dry air all three compounds are canary-yellow, but lose their color on contact with moisture. Aniline hydriodide gave with antimony triiodide three salts in which the ratios of base to antimony were 1 : 1, 3 : 2, and 4 : 1. From *o*-toluidine hydriodide and antimony triiodide the 1 : 1 and 3 : 2 salts were obtained; from *m*-toluidine hydriodide the 3 : 2 salt; from *p*-toluidine hydriodide the 1 : 1 salt.

A Preliminary Study of the Cobalticyanides. BY E. H. MILLER AND J. A. MATHEWS. *J. Am. Chem. Soc.*, 22, 62-69.—The cobalticyanides of silver, mercury, copper, bismuth, cadmium, iron, manganese, zinc, cobalt, and nickel were made by bringing together half-normal solutions of potassium cobalticyanide with half-normal solutions of the metals. The composition of the precipitates and their solubilities in various reagents were studied qualitatively only.

The Carbide of Gold. BY J. A. MATHEWS AND L. L. WATERS. *J. Am. Chem. Soc.*, 22, 108-111.—By passing acetylene into a strongly ammoniacal solution of sodium aurous thiosulphate there is formed, after some time, a yellow, flocculent precipitate which, after having been dried over sulphuric acid,

gives on analysis figures which correspond to the formula Au_2C_2 . Carbide of gold is highly explosive. Water decomposes it into its elements; hydrochloric acid liberates acetylene.

On the Decomposition of Nickel Carbonyl in Solution. BY VICTOR LENHER AND HERMANN A. LOOS. *J. Am. Chem. Soc.*, **22**, 114-116.—The authors have confirmed the experiments of Berthelot, Mond, and others, that nickel carbonyl is decomposed by moisture. When dissolved in acetone, chloroform, benzene, toluene, or methyl alcohol, there is produced a green precipitate, the composition of which seems to be variable.

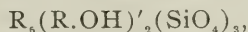
GEOLOGICAL AND MINERALOGICAL CHEMISTRY.

M. L. FULLER, REVIEWER.

Some New Minerals from the Zinc Mines at Franklin, N. J., and Note Concerning the Chemical Composition of Ganomalite.

BY S. L. PENFIELD AND C. H. WARREN. *Am. J. Sci.*, **158**, 339-353.—The new minerals hancockite, nasonite, glaucochroite, and leucophoenicite were taken mostly from the 1000-foot level of the Parker Shaft on North Mine Hill, where they are associated with native lead and copper, clinohedrite, roebbingite, axinite, willemite, vesuvianite, datolite, barite, garnet, phlogopite, and franklinite. Careful analyses were made of each of the new minerals, and their formulæ computed. 1. Hancockite. This is a brownish-red mineral crystallizing in very minute, lath-shaped crystals, resembling those of epidote, of hardness 6.5-7, and specific gravity 4.030. The analysis gives the empirical formula $\text{H}_2\text{R}''_2(\text{R}'''\text{OH})\text{R}''''_2(\text{SiO}_4)_3$ or $\text{R}''_2(\text{R}'''\text{OH})\text{R}''''_2(\text{SiO}_4)_3$. The general formula is that of epidote, differing principally in having the bivalent metals lead (18.53 per cent.) and strontium (3.89 per cent.) isomorphous with calcium. It should be placed, therefore, in the epidote group next to piedmontite. It is named after E. P. Hancock, of Burlington, N. J. 2. Glaucochroite. Glaucochroite occurs in small orthorhombic prisms or columnar aggregates, and is sometimes twinned. It has a hardness of about 6, a specific gravity of 3.407, and in color is a delicate bluish-green. The analysis, disregarding 1.74 per cent. of lead, gives the formula CaMnSiO_4 , which places it next to monticellite in the chrysolite group. The name is from the Greek, meaning *bluish-green color*. 3. Nasonite. This is a white, massive mineral with greasy to adamantine luster, hardness about 4, specific gravity 5.425, and usually shows numerous inclusions of axinite, garnet, and glaucochroite. Its crystallization is probably tetragonal, though this could not be proved. The analyses show the general formula to be $\text{R}_{10}\text{Cl}_2\text{Si}_6\text{O}_{21}$, in which R is mostly lead and calcium. Allowing for a few particles of clinohedrite that were

noticed intimately associated with the nasonite the empirical formula $\text{Pb}_6\text{Ca}_4\text{Cl}_2(\text{Si}_2\text{O}_7)_3$ or $\text{Pb}_4(\text{PbCl})'_2\text{Ca}_4(\text{Si}_2\text{O}_7)_3$ is obtained. It is named for F. L. Nason, West Haven, Conn. 4. Leucophoenicite. This mineral, which is conspicuous on account of its light purplish-red color, occurs in small crystalline masses having vitreous luster, hardness 5.5–6, and specific gravity 3.848. The system of crystallization could not be determined but is probably inclined. The analyses gave the formula



in which R is mostly Mn, but with some Zn and Ca. Structurally it is the exact equivalent of humite. The name is from the Greek, meaning *pale purple-red*. 5. Chemical Composition of Ganomalite. From a study of analyses, and of the analogous mineral nasonite, the authors are led to discard the formula $\text{Pb}_5\text{Ca}_5\text{Si}_5\text{O}_{11}$ for ganomalite and to substitute the formula $\text{Pb}_4(\text{Pb.OH})'_2\text{Ca}_2(\text{Si}_2\text{O}_7)_3$. Both nasonite and ganomalite are salts of the acid $\text{H}_6\text{Si}_2\text{O}_7$, which is intermediate between the orthosilicic acid H_4SiO_4 and metasilicic acid H_2SiO_3 . The name *mesosilicic acid* (*meso* from the Greek, meaning *between*) is suggested for this intermediate acid in place of Groth's name *di-orthosilicic acid*, which the authors consider inappropriate, as the acid in question is not an orthosilicic acid, as the name would signify, but is a derivative of orthosilicic acid.

Andesites of the Aroostook Volcanic Area of Maine. By HERBERT E. GREGORY. *Am. J. Sci.*, **158**, 359–369.—The paper includes descriptions of the field relations and petrography of the andesite area in the towns of Chapman, Mapleton, and Castle Hill, Aroostook Co., Maine. The andesites are Paleozoic lava flows and breccias, with their associated tuffs, lying upon the upturned edges of Silurian sandstone. The augite and hornblende types predominate, but stages between andesite and trachyte, and also dacite facies are sometimes found. Exhaustive analyses show that the Maine andesites agree with the types of their class. No more alteration is found than in many of the comparatively recent flows.

On a New Mode of Occurrence of Ruby in North Carolina. By J. W. JUDD AND W. E. HIDDEN. **Crystallographic Notes.** By J. H. PRATT. *Am. J. Sci.*, **158**, 370–381.—The Cowee district, which is the locality of the rubies described, is in Macon County, a few miles north of the town of Franklin. The rubies occur mostly in tabular rhombohedral or short prismatic crystals in a basic, garnet-bearing, crystalline rock, and often inclose small crystals of the garnet rhodolite. The mode of occurrence resembles in many points that of the rubies in the crystalline

limestone of Burma. The difference in the matrix in the two instances would be of less significance if it could be established, as has been urged by one of the authors, that the Burma limestone has resulted from the slow alteration of a lime feldspar.

Note on a New Meteoric Iron found near Iredell, Bosque County, Texas, U. S. A. BY WARREN M. FOOTE. *Am. J. Sci.*, 158, 415-416.—This meteorite, some three pounds in weight, presented a somewhat rusty surface with a slight exudation of lawrencite and streaks of schreibersite. The cleavage, though not well marked, was apparently dodecahedral. An analysis showed the presence of 93.75 per cent. of iron, 5.51 per cent. of nickel, and slight amounts of cobalt, phosphorus, and sulphur. Weak etching figures were developed by dilute nitric acid.

On a New Occurrence of Nepheline Syenite in New Jersey. BY F. LESLIE RANSOME. *Am. J. Sci.*, 158, 417-426.—The syenite described was found near the town of Brookville, where it occurs in gabbroitic trap intrusive into the Newark formation. The exposures are not sufficiently good to definitely establish the relations of the syenite and trap, but the author considers that the syenite is to be regarded as dike-like intrusions, or inclosures brought up from some underlying formation, rather than as a product of magmatic differentiation of the trap. The syenite is of three varieties, nepheline syenite, hornblende syenite, and biotite syenite. In addition to the description of the occurrence and characters of the rock a very complete chemical analysis is given.

On Graftonite, a New Mineral from Grafton, New Hampshire, and Its Intergrowth with Triphylite. BY S. L. PENFIELD. *Am. J. Sci.*, 159, 20-32.—The graftonite occurs in pegmatite, where it is found as a lamellar intergrowth with triphylite. The form of the crystals is monoclinic. When fresh the mineral has a delicate salmon color resembling that of lithiophilite, but on account of the oxidation of the iron, principally in the triphylite, the color is usually dark. The specific gravity is 3.672, hardness 5, and luster vitreous to resinous. The analysis, the method of which is described in outline, gave the formula $R_3P_2O_8$, in which R stands for bivalent iron, manganese, and calcium. Detailed descriptions of its optical and crystalline properties, with a discussion of its intergrowth with triphylite, is also given.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. VI. No. 5.

ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

GENERAL AND PHYSICAL CHEMISTRY.

A. A. NOYES, REVIEWER.

A Revision of the Atomic Weight of Cobalt, III. The Analysis of Cobaltous Chloride and Oxide. BY THEODORE WILLIAM RICHARDS AND GREGORY PAUL BAXTER. *Proc. Am. Acad.*, 35, 61-72.—Cobaltous chloride was purified by passing air through its ammoniacal solution, precipitating with hydrochloric acid the purpureo-cobaltic chloride formed, recrystallizing this six times from ammonia solution in a platinum dish, precipitating in a Jena flask with hydrochloric acid, and heating the precipitate first in an air-bath at 200° , and then in a current of nitrogen and hydrochloric acid to expel ammonium chloride. The weighed cobaltous chloride was reduced to cobalt by hydrogen, the small quantity of alkaline chloride present in the metal and of ammonium chloride volatilizing during the reduction being determined and corrected for. The atomic weight value so obtained was 59.044, against 58.995 previously found from the analyses of cobaltous bromide (*this Rev.*, 5, 43), but the authors regard the new value as undoubtedly too large, owing to the presence of impurity, probably silica, in the chloride. The authors also attempted to prepare a cobaltous oxide of definite composition by igniting the higher oxide in a nearly complete vacuum of varying pressure, but found by reducing with hydrogen that the atomic weight values varied from 58.93 to 59.07. They conclude that the higher oxide could not be entirely decomposed without causing some reduction of the monoxide to metal cobalt. They regard the value 58.995 obtained from the analysis of the bromide as the most probable one. The article closes with a critical review of previous determinations.

Are Further Experiments Needed for Determining the Atomic Weight of Oxygen? BY EDWARD W. MORLEY. *J. Am. Chem. Soc.*, **22**, 51-61; *Science*, **11**, 281-288.—The author recalls the fact that our present value of the atomic ratio between hydrogen and oxygen is based solely on the composition of one compound, water, and on two methods of its determination, its synthesis by weight and the volumetric ratio taken in connection with the densities of the component gases, and suggests that the certainty attaching to the ratio would be greatly increased by a new complete synthesis of water by an independent method, and by further experiments on the density of hydrogen and on the volumetric ratio. He also considers probably practicable an accurate complete synthesis of hydrochloric acid from its elements and a determination of the ratio Na : H by dissolving sodium in water and determining the loss in weight. He raises, however, at the close the question whether the value of the results to science would justify the great labor involved in these investigations, and desires an expression of opinion on this point. In view of the fact that the atomic ratio of hydrogen and oxygen is stoichiometrically one of the most important of all chemical constants, and is likely also to have great significance theoretically, it seems certain to the reviewer that scientists will not rest satisfied until that ratio has been established with the greatest possible certainty and accuracy, and it seems therefore highly desirable that an investigator who possesses the rare manipulative skill, the critical appreciation of sources of error, and the long experience, required for the successful prosecution of such researches, should continue to devote himself to them.

The Nature of the Change from Violet to Green in Solutions of Chromium Salts. BY F. P. VENABLE AND F. W. MILLER. *J. Am. Chem. Soc.*, **20**, 484-497.—The authors describe experiments on the fraction (found to be two-thirds) of the total sulphuric acid that is precipitated by barium chloride from green chrome alum solutions, on the amounts of ammonia required to produce a permanent precipitate in the green and violet solutions (found to be equal in the two cases), and on the composition of the gummy precipitate produced by adding alcohol to the green solution. They conclude from their experiments that the hypothesis of Recoura that the green chromium sulphate exists in solution as $\text{Cr}_4\text{O}(\text{SO}_4)_4 \cdot \text{SO}_4 + \text{H}_2\text{SO}_4$ is untenable.

The Nature of the Change from Violet to Green in Solutions of Chromium Salts. BY W. R. WHITNEY. *J. Am. Chem. Soc.*, **21**, 1075-1084.—In a previous article (see the preceding review) Venable and Miller claim to have refuted the hypothesis of Recoura as to the composition of green chromium sul-

phate. After presenting ten facts previously known as evidence of the presence of free sulphuric acid, the author describes the results of transference experiments of his own, in which the theoretical amount of free acid was actually caused to migrate out from the green solution, while practically no acid was separated by the current from the violet solution. The author also communicates experiments confirming those of Favre and Valson to the effect that only about one-half of the sulphuric acid in a green solution of chrome alum is precipitated immediately in the cold, and points out that the different results of Venable and Miller are no doubt due to the fact that they waited twenty-four hours before filtering off the barium sulphate. He also points out that their experiments, showing that equal quantities of ammonia are required to barely precipitate the green and violet solutions, do not have the significance attributed to them, since it is well known that alkalis at once convert the violet into the green modification.

The Nature of the Change from Violet to Green in Solutions of Chromium Salts. BY F. P. VENABLE. *J. Am. Chem. Soc.*, 22, 111-114.—After stating the reasons for the contrary opinion maintained in a previous article (see above), and otherwise interpreting some of the results there described, the author accepts the hypothesis of Recoura upheld by Whitney (see the preceding review), that a green solution of chromium sulphate has the composition, $\text{Cr}_4\text{O}(\text{SO}_4)_4 \cdot \text{SO}_4 + \text{H}_2\text{SO}_4$.

The Relation of Physical Chemistry to Technical Chemistry. BY WILDER D. BANCROFT. *J. Am. Chem. Soc.*, 21, 1101-1107.—The author emphasizes the importance of a knowledge of the principles of physical chemistry to the manufacturing chemist, and maintains that aside from the value of this knowledge, physico-chemical research is a better training for industrial work than research in synthetic organic chemistry. The reviewer is also of this opinion, especially with reference to this country, where the positions filled by chemists involve, as a rule, the improvement and development of processes rather than the synthetic production of new compounds.

On the Surface-tensions of Mixtures of Sulphuric Acid and Water, and the Molecular Mass of Sulphuric Acid. BY C. E. LINEBARGER. *J. Am. Chem. Soc.*, 22, 5-11.—The author has determined for each 10° between 0° and 50° or 70° the surface-tensions of aqueous sulphuric acid of strengths varying from 2.65 up to 95.0 per cent. acid. He finds that the surface-tension of the strongest acid is greatly increased by the addition of relatively small amounts of water, and is but slightly affected by

rise of temperature. The latter fact is considered to point to a high degree of polymerization of the sulphuric acid molecules.

Seventh Annual Report of the Committee on Atomic Weights. Results Published in 1899. BY F. W. CLARKE. *J. Am. Chem. Soc.*, 22, 70-80.—The average values of the atomic weights published last year and compiled by the author are given below, the values in parentheses being those adopted by the author in his previous report. All values are referred to oxygen taken as 16.000:

| | | |
|------------------------------------|---------|----------|
| Boron, Gautier..... | 11.016 | (10.95) |
| Nitrogen, Dean..... | 14.031 | (14.04) |
| Calcium, Richards..... | 40.126 | (40.07) |
| Nickel, Richards and Cushman | 58.709 | (58.69) |
| Cobalt, Richards and Baxter | 58.995 | (58.99) |
| Molybdenum, Vandenbergh..... | 96.069 | (95.99) |
| Tungsten, Hardin..... | 184.0 | (184.83) |
| Cerium, Kölle | 138.81 | (139.35) |
| Palladium, Hardin..... | 107.014 | (106.36) |

On Some Abnormal Freezing-point Lowerings Produced by Chlorides and Bromides of the Alkaline Earths. BY HARRY C. JONES AND VICTOR J. CHAMBERS. *Am. Chem. J.*, 23, 89-105.—The molecular lowerings of the chlorides and bromides of barium, strontium, calcium, and magnesium are all found to have a minimum value of 4.8° - 5.1° between the concentrations 0.1 and 0.2 molecule per liter. The values increase considerably with increasing concentration (in most cases up to 5.4° - 5.8° at 0.6 mol per liter), in spite of the fact that the dissociation is continually decreasing, as is shown by the electrical conductivity measurements which are also given by the authors for all eight salts over a wide range of concentration. The authors suggest that the abnormal freezing-point values may arise from the combination of the undissociated salt-molecules with a large number of water molecules, thereby reducing appreciably in the concentrated solutions the amount of solvent. Freezing-point and conductivity determinations are also given for solutions of cadmium chloride and bromide, but in these cases the molecular freezing-point lowering exhibits no minimum, but steadily decreases with rising concentration.

The Melting-point of Chloral Hydrate. BY C. G. L. WOLF. *J. Phys. Chem.*, 4, 21-32.—The author has determined the melting-point of chloral hydrate under different conditions, and concludes that the variations in it found by him and previous investigators are due, not to the existence of an isomeric form, but to the presence of dissociation-products in varying amounts. When a thermometer bulb was coated with chloral hydrate and heated in a vacuum, these conditions being such that the dissociation-

products could rapidly escape as vapors, the substance did not melt below 72° , at which point rapid sublimation took place, however. On the other hand, when it was heated in a closed tube, time being allowed for equilibrium to be reached between the solid, liquid, and vapor, the melting-point was about 47° .

The Relation of the Taste of Acid Salts to Their Degree of Dissociation. BY LOUIS KAHLENBERG. *J. Phys. Chem.*, 4, 33-37.—The author finds that the acid sodium salts of oxalic, malonic, succinic, malic, tartaric, fumaric, maleic, and citric acids all taste still noticeably sour in solutions containing one mol in 100-400 liters, varying only between these narrow limits, with the nature of the salt. The variation in sourness is thus very much less than the variation (1 : 70 in the extreme case) in the concentration of the hydrogen ions in the different salt solutions. Moreover, the sourness of acid sodium tartrate and malate solutions, where the dissociation is not more than a few per cent., was found to be nearly equal to that of hydrochloric acid only three times as dilute, confirming the result of Richards with acetic and hydrochloric acids, that the sourness does not depend solely on the concentration of the hydrogen ions. The author concludes that, if his results are to be interpreted by the dissociation theory, the univalent anions ($\text{COOH}-\text{COO}$, etc.) must, like the hydrogen ion, be assumed to have a sour taste, an "explanation which is unsatisfactory to say the least." This explanation does not, however, seem a necessary, or even a probable one, to the reviewer, for the intensity of the sour taste probably depends on the amount of some unknown chemical change produced by the acid in the ends of the sensory nerves in a short interval of time. If this change was caused catalytically by the hydrogen ions, one might expect proportionality between its rate and the concentration of those ions. If, however, the hydrogen ions directly enter into the reaction and are consumed by it, their concentration in the layer in immediate contact with the nerve will be rapidly reduced, especially if the acid solution is dilute; and the hydrogen ions so removed can be replaced, in case the acid is completely dissociated, only by the slow processes of diffusion and convection, while if the acid is more concentrated but only slightly dissociated, an immediate new supply of hydrogen ions is furnished by the instantaneous process of dissociation. Thus, according to this hypothesis, which is *a priori* as reasonable as the other, the degree of sourness of a dilute acid solution will, in general, depend on the total concentration of the acid as well as on the concentration of the hydrogen ions, which is, in fact, the principle which expresses the experimental results thus far reached.

On Thermal and Dynamic Coefficients. BY J. E. TREVOR. *J. Phys. Chem.*, 3, 573-576.—The article is a continuation of the general discussion of the partial derivatives of the four fundamental thermodynamic functions (*this Rev.*, 6, 9).

On the Emission and Absorption of Water Vapor by Colloidal Matter. BY P. DUHEM. *J. Phys. Chem.*, 4, 65-122.—The article consists of an extended mathematical discussion of the phenomenon named in the title, when it is affected by hysteresis, and of an application of the conclusions reached to von Bemmelen's observations on the dehydration of gelatinous silica and colloidal ferric hydroxide.

The Melting-point of Formyl Phenyl Acetic Ester. BY C. G. L. WOLF. *J. Phys. Chem.*, 4, 123-129.—The article is largely devoted to a discussion of the observation that the ester, after heating at 100° for some hours (by which it is melted and converted in large part into the enol form), separates crystals of the keto form more quickly if the liquid is first cooled to -80° and then allowed to stand at 20° than if it is cooled directly to 20° and allowed to stand, the difference being attributed to a more rapid reconversion into the keto form, arising from the fact that the temperature in the former case is much further below the equilibrium temperature. Thus fall of temperature may accelerate a reaction.

Freezing-point Curve for Water Containing Hydrochloric Acid and Phenol. BY J. A. EMERY AND F. K. CAMERON. *J. Phys. Chem.*, 4, 130-134.—The authors have determined the freezing-points of water and hydrochloric acid solutions, 0.024-0.500 normal, when saturated with phenol. The lowerings are found to be the sums of the lowerings caused by the two substances separately. The freezing-point of the saturated aqueous solution of phenol is -1.179°.

Thermal Effects of the Dilution of Some Salts. BY F. P. DUNNINGTON AND T. HOGGARD. *Am. Chem. J.*, 22, 207-211.—The authors have determined the heat effect resulting when, to nearly saturated solutions of fifteen neutral ammonium, potassium, sodium, lithium, magnesium, calcium, and strontium salts, water is added, one molecule or a few molecules at a time. The heat of dilution was found to be positive for seven of the salts, negative for seven others, and positive for the first additions of water, and then negative for subsequent additions in the case of the remaining salt, calcium nitrate. The values for the first mol of water added are greatest for lithium, calcium, and magnesium chlorides (+678, +508, and +370 cal.).

A Contribution to the Study of Liquid Mixtures of Constant Boiling-point. BY GARNETT RYLAND. *Am. Chem. J.*, 22, 384-396.—The author has fractionated mixtures of eighty pairs of liquids boiling separately less than 40° apart, and finds that 45 of them yield a constant boiling fraction of the same or lower boiling-point than the more volatile constituent, two of them, such a fraction of a higher boiling-point than the less volatile constituent, and one of them, ethyl iodide (b. p. 72°) and benzene (b. p. 79°), a fraction boiling (at 74° - 75°) between the boiling-points of the two constituents. This last case, which is rather remarkable from a theoretical standpoint, is further exemplified by an earlier observation of Bauer on a mixture of ethylene and propylene bromides. As this case does not seem to have been hitherto considered theoretically, the reviewer would point out that if the vapor-pressure for any composition of the mixture has a minimum value lying between the two limiting vapor-pressures of the pure liquids, it must necessarily have also a maximum value for some other composition, or *vice versa*, and therefore it must be possible to obtain *two different* mixtures of constant boiling-point, a conclusion which it would be interesting to test experimentally. The author gives the composition, determined by repeated trials of synthetic mixtures, and the boiling-point under atmospheric pressure, of the various constant boiling mixtures; and compares the observed composition of many of them with that calculated under the assumption that each component volatilizes in gaseous volumes proportional to its own vapor-pressure in the pure state at the boiling-point of the mixture. In almost all cases the so-calculated values are much larger for the less volatile, less concentrated component than the observed ones, a result which is, however, in accord with the law of Raoult, which requires that the vapor-pressure of the smaller component be relatively more reduced than that of the larger component. In the case of the mixtures of methyl alcohol and benzene and of ethyl alcohol and benzene, distillations were made at different pressures (22-77 cms.), the composition of the constant boiling fractions being then found to vary several per cent. In concluding, the author emphasizes the very *common* occurrence of mixtures of constant boiling-point and the consequent frequent impossibility of separating liquids by fractional distillation.

On a Hypothesis to Explain the Partial Non-explosive Combination of Explosive Gases and Gaseous Mixtures. BY W. G. MIXTER. *Am. J. Sci.*, 157, 327-334.—The fact that explosions do not occur by sparking explosive mixtures of gases when their pressure is less than a certain limiting value is attributed to the infrequency of impacts of molecules having a velocity or inter-

nal energy adequate for chemical union, there being more time in a rare gas than in a dense one for a molecule with energy adequate for combination to lose this energy by radiation.

On the Applicability of the Dissociation Theory to the Electrolysis of Aqueous Solutions Containing Two Electrolytes with a Common Ion. BY J. G. MACGREGOR. *Phys. Rev.*, 8, 129-140.—The author has calculated from the known dissociation-values and transference numbers of the component salts, the transference relations which should prevail in a mixture of two salts with a common ion, and compares the calculated results with those observed by previous investigators. The agreement is only a rough one. The author calculates the dissociation constants of the salts in question at different concentrations with the help of the ordinary mass-action law, disregarding the now well-established fact that they do not conform to that law.

The Conductivity and Dissociation of Some Electrolytes. BY WILLIAM FOSTER, JR. *Phys. Rev.*, 8, 257-281.—The author has determined the electrical conductivity of solutions of ammonium nitrate, magnesium sulphate, magnesium chloride, sodium ammonium hydrogen phosphate, disodium hydrogen phosphate, and potassium dihydrogen phosphate, of sodium hydroxide, and of phosphoric, oxalic, and citric acids, at concentrations varying from 1.0 to 0.0001 equivalents per liter. The temperature coefficients of conductivity and the specific gravities of normal solutions of these substances were also determined. The degrees of dissociation are calculated for all these substances at the various dilutions and compared with Loomis' results by the freezing-point method. The agreement is close except in the cases of the magnesium salts where differences of 10 to 20 per cent. occur, and of sodium hydroxide and potassium dihydrogen phosphate, where the differences are about 5 per cent.

H. M. GOODWIN, REVIEWER.

The Electrochemical Equivalents of Copper and Silver. BY THEODORE W. RICHARDS, EDWARD COLLINS, AND GEORGE W. HEIMROD. *Proc. Am. Acad.*, 35, 123-150.—This valuable contribution to electrochemistry should be read by all interested in the determination of the fundamental electrochemical constant. The investigation was undertaken primarily to reconcile, if possible, the discrepancy existing between the atomic weight of copper as determined by electrochemical and by purely chemical methods. A very careful study was first made of the conditions to be observed in a copper voltameter, and the effect of the various sources of error introduced by variable current density, acidity of solution, etc., is minutely discussed. A number of experi-

ments in which two copper voltameters with electrodes of 50 sq. cm. and 25 sq. cm. surface respectively, in series with two silver voltameters, gave the following results for the electrochemical atomic weight of copper :

| | |
|---|------------------|
| Uncorrected results of Rayleigh, Gray, Shaw, Vanni, etc | { 63.30 to 63.50 |
| Large plates in cupric solutions at 20°..... | 63.47 |
| “ “ “ “ “ “ 0°..... | 63.525 |
| Small “ “ “ “ “ “ 0°..... | 63.547 |
| Medium “ “ cuprous “ “ “ 0°..... | 63.573 |
| “ “ “ “ “ “ 60°..... | 63.615 |
| Corrected results for cupric solutions..... | 63.563 |
| At. wt. copper by chemical processes..... | 63.604 |
| Discrepancy | 0.041 |

The experiments designated “in cuprous solutions” were made with copper sulphate which had been, by previous electrolysis with an alternating current, saturated with cuprous salt ; they were carried out to determine the maximum value for the electrochemical atomic weight, since if any cuprous ions carry a part of the current the deposit should be too great. The increase in value with rise of temperature (producing increase in solubility of cuprous salt) proves this to be the case, so that 63.573 can be taken as an extreme upper limit. The discrepancy between the chemical and electrochemical atomic weight is thus seen to be greater than the experimental error of either determination, and the authors therefore sought the cause in the silver voltameter. By a very careful investigation of this they were able to show that the effect well known to previous investigators that the deposit of silver in a silver voltameter depended on whether the solution had been previously used or not, arose from the formation of a substance in the neighborhood of the silver anode, which tended to deposit too much silver if allowed to diffuse to the cathode. The form of silver voltameter was therefore changed, the anode being placed within a porous cell, and this compared with Lord Rayleigh’s and Patterson and Guthe’s form of voltameter. In all cases the new form of voltameter gave the lowest results. The difference amounted to 0.081 per cent. Correcting the atomic weight of copper referred to the ordinary silver voltameter by this amount the authors find its value must lie between 63.598 and 63.615 as outside limits. The chemical value 63.604 lies between these values, in truth, “a remarkable confirmation of the results of the porous cup voltameter.” The mean of the corrected values of Lord Rayleigh and Mrs. Sidgwick, F. and W. Kohlrausch, Kahle, and Patterson and Guthe gives 0.0011173 gram silver per ampere second, or 0.0011172 as the mean of the extreme values. On

this latter basis one gram equivalent of an electrolyte transports 96610 coulombs of electricity instead of 96540, the value usually assumed. The investigation furnishes probably the most rigid experimental proof of Faraday's law yet published.

The Influence of Temperature, Pressure, Used Solutions, and Size of Anodes on the Deposit of Silver Voltameters. By J. F. MERRILL. *Phys. Rev.*, **10**, 167-175.—Pressures up to 103 atmospheres had no effect on the amount of silver deposited, nor did a variation of temperature from 0° to 90° C. The results with five old solutions compared with freshly prepared solutions showed the deposit to be greater from the former by about 1 part in 11600. Later, the old solution, after being repeatedly used, gave an increase of as much as one part in 1700. The solution did not become acid, however, if it had been boiled. The size of the anodes, except in extreme cases, has no appreciable influence. The nature of the surface of the cathode seems to have a slight effect.

The Influence of Electrification upon the Surface Tension of Water and Mercury. By ERNEST MERRITT AND SAMUEL J. BARNETT. *Phys. Rev.*, **10**, 65-74.—The authors show by a careful theoretical discussion of the method employed by Barnett for determining the effect of electrification on the surface-tension of water and mercury (*Phys. Rev.*, **6**, 257, 1898) that the effects observed can be wholly accounted for by purely electrostatic effects, and that therefore no effect of pure electrification upon surface-tension has yet been observed. The electro-capillary phenomena of mercury in contact with electrolytes are, of course, not here considered.

Polarization and Internal Resistance of Copper Voltameter. By B. E. MOORE. *Phys. Rev.*, **10**, 34-52.—By a somewhat elaborate system of circuit breaking and making devices, for details of which reference must be made to the original, the author has measured the total polarization produced by direct currents at the electrodes of a copper voltameter, at times varying from 0.00006 second to 0.045 second after the polarizing electromotive force has been removed. The results are discussed graphically, and the author concludes that, if the true maximum value of the polarization (P) could be measured, the simple formula $r = \frac{E-P}{i}$ would give very nearly the true value of the resistance (r) of electrolytes for all current strengths.

The Electrolytic Reduction of Potassium Chlorate. By ADOLPH L. VOEGE. *J. Phys. Chem.*, **3**, 577-601.—The reduction of this salt was experimentally studied under as varied con-

ditions as possible, and the following conclusions reached: The reduction is greater in acid than in alkali solution, and varies with the strength of acid; it increases greatly with the temperature, and increases also with decreasing current density; this last influence, however, varies with the nature of the metal used for the electrodes, copper, zinc, cadmium, and platinum having been studied.

The Electrochemical Equivalent of Carbon. BY H. C. PEASE. *J. Phys. Chem.*, **4**, 38-41.—The mean of five experiments on the loss of weight of a carbon anode in fused potassium hydroxide in an electrolytic cell with an iron cathode gave 3.32 as the equivalent weight of carbon. Coehn found the value in sulphuric acid to be 3.0. Carbon thus comports itself in these electrolytes as a quadrivalent element.

On the Inversion of the Hepta- and Hexahydrates of Zinc Sulphate in the Clark Cell. BY H. T. BARNES. *J. Phys. Chem.*, **4**, 1-21.—The paper contains the complete results of experiments published by Callendar and Barnes in 1897 (*Proc. Roy. Soc.*, **62**, 150) on the change of hydration of zinc sulphate crystals indicated by the change in temperature coefficient of a Clark cell in the neighborhood of 39° C. The temperature coefficient of cells of various forms was measured from 15° to 50°, and formulæ for the electromotive force deduced for various intervals. The electromotive force curves for cells containing the hepta- and hexahydrates of zinc sulphate cross at 38.78° C., which therefore corresponds to the transition temperature. From solubility experiments the transition temperature is 39.95°. The difference is explained by a secondary influence due to the presence of the mercurous sulphate in the Clark cell.

The Electrolytic Deposition of Brass. BY J. LIVINGSTON R. MORGAN. *J. Am. Chem. Soc.*, **22**, 93-99.—An attempt to explain the process of brass plating on the basis of the osmotic theory of the cell. The explanation does not seem clear to the reviewer, and is not verified by any experimental data.

The Specific Gravity and Electrical Resistance of Metallic Tellurium. BY VICTOR LENHER AND J. LIVINGSTON R. MORGAN. *J. Am. Chem. Soc.*, **22**, 28-31.—The tellurium was prepared by reducing an alkaline solution of the oxide by means of sugar (Lenher). For the specific gravity of the powdered metal 6.1993 was found as a mean of three determinations at 20°. The specific resistance was determined by casting the metal in rods of various lengths (57.5 mm. to 162 mm.) and diameters (2.92 mm. to 8.89 mm.) and measuring their resistance by the usual bridge method. Contact was made by means of mercury.

The values obtained for the specific resistance vary from about 300 to 1150; the mean, about 500, is only about one-fourth of the value found by Matthieson.

ANALYTICAL CHEMISTRY.

ULTIMATE ANALYSIS.

H. P. TALBOT, REVIEWER.

The Iodometric Determination of Small Quantities of Carbon Monoxide. BY LEONARD P. KINNICUTT AND GEORGE R. SANFORD. *J. Am. Chem. Soc.*, 22, 14-18.—The carbon monoxide is passed over iodine pentoxide at a temperature of 150°, and the reduced iodine is collected in a potassium iodide solution and titrated with thiosulphate solution. Accurate determinations were made when the amount of the monoxide in the air was as small as 2.5 parts in 100,000.

The Volumetric Determination of Magnesia. BY JAMES OTIS HANDY. *J. Am. Chem. Soc.*, 22, 31-39.—The precipitate of magnesium ammonium phosphate, thrown down under definite conditions, is collected upon a filter, washed with dilute ammonia, and the filter exposed to the air until the ammonia has volatilized, which is found to be the case when the filter has dried about one-half inch from its circumference. The precipitate and filter are then treated with standard sulphuric acid in excess, and after complete solution the excess is determined by titration with standard sodium hydroxide solution, using methyl orange as an indicator.

Notes: The Retention of Moisture by Asbestos, and The Determination of Graphite by Loss. BY GEORGE AUCHY. *J. Am. Chem. Soc.*, 22, 46-48.

The Determination of Sulphur in Bitumens. BY A. C. LANGMUIR. *J. Am. Chem. Soc.*, 22, 99-102.—The author comments upon the criticisms made by S. F. and H. E. Peckham (*this Rev.*, 5, 100) upon an article by E. H. Hodgson (*this Rev.*, 5, 10). He prefers the Eschka method as modified by Heath (*this Rev.*, 4, 121). While it is undoubtedly true that the sulphur in illuminating gas is often a source of considerable error in sulphur determinations, it seems to the reviewer doubtful whether the data given by von Meyer and quoted by Langmuir are of general application. It is certainly true that Boston gas, for instance, introduces much less sulphuric acid during evaporations, even under unfavorable conditions, than was found by von Meyer in his laboratory.

The Determination of Nickel in Nickel Ores. By A. C. LANGMUIR. *J. Am. Chem. Soc.*, 22, 102-106.—The ore is dissolved in nitric acid, this acid replaced by hydrochloric acid, the copper thrown out as sulphide, and the iron oxidized and precipitated once by ammonia. This precipitate is dissolved in hydrochloric acid, and the solution extracted with ether to separate most of the iron, the remaining iron being twice precipitated by ammonia. The ammonium chloride in the filtrate is destroyed by boiling with nitric acid, and finally the solution is evaporated with sulphuric acid, made ammoniacal, and electrolyzed. The procedure given is an adaptation of well-known methods to the special case of nickel ores.

Substitutes for Hydrochloric Acid in Testing Carbonates. By JOSEPH W. RICHARDS AND NORMAN S. POWELL. *J. Am. Chem. Soc.*, 22, 117-121.—With the purpose of obtaining a substitute for hydrochloric acid in the test for carbonates in field-work the authors studied the action of solutions of potassium acid sulphate, oxalic, citric, and tartaric acids upon various natural carbonates. Tartaric acid proved to be most efficient, followed by citric and oxalic acids. A table shows the effect of each reagent upon a variety of carbonates at varying temperatures.

Report of Committee on Coal Analysis. By WILLIAM A. NOYES, W. F. HILLEBRAND, AND C. B. DUDLEY. *J. Am. Chem. Soc.*, 21, 1116-1132.—This is a final report of the committee and describes the procedures which they consider efficient for coal analysis.

W. H. WALKER, REVIEWER.

The Constitution of the Magnesium Ammonium Arseniate of Analysis. By MARTHA AUSTIN. *Am. J. Sci.*, 159, 55-61.—When magnesium ammonium arseniate is formed by the addition of magnesia mixture to a solution of arsenic acid, the presence of an excess of ammonium chloride causes a replacement of some of the magnesium by ammonium, forming possibly the salt $Mg(NH_4)(AsO_4)_2$. A precipitate of the ideal constitution is thrown down, however, when an amount of the ammoniacal magnesia mixture slightly in excess of that theoretically necessary to precipitate the arsenic present is added to the faintly acid solution of arsenic acid, containing no ammonium salt, in a volume not exceeding 200 cc. This precipitate may be washed with a faintly ammoniacal wash-water and ignited to pyroarsenate without appreciable loss.

On the Estimation of Thallium as the Acid and Neutral Sulphate. By PHILIP E. BROWNING. *Am. J. Sci.*, 159, 137-

138.—The suggestion of previous investigators that both the acid and neutral sulphates of thallium might be used in the estimation of this element has been carried out by the author with positive results. By treating thallium chloride with sulphuric acid and heating to constant weight at 220° – 240° C., the salt was found to correspond to the acid sulphate. When heated to dull redness, sulphuric acid escaped, and when constant weight was again attained, the residue had the composition of the neutral sulphate.

Laboratory Notes. BY J. M. CAMP. *Iron Age*, 65, 17–18.—In these notes are included detailed directions for the determination of phosphorus in coal and coke, and in ores, pig-iron, and steel which contain also arsenic. A method for the estimation of alumina in slags and ores is proposed, in which the aluminum is separated and weighed as aluminum phosphate.

Silicon in Ferrosilicon. BY F. W. BAUER. *Iron Age*, 65, 3.—The percentages of silicon in a sample of ferrosilicon as reported by eleven chemists, working independently, are given, together with an outline of the method used by each. The results vary from 14.90 per cent. to 16.68 per cent. silicon.

A Rapid Method for Determining Lime in Blast-furnace Slags. BY TITUS ULKE. *Eng. Min. J.*, 69, 164.—The sample of slag is dissolved in very dilute nitric acid, and any barium present is precipitated by the addition of a few drops of sulphuric acid. The solution is now made almost neutral with dilute ammonia, and the calcium precipitated by the addition of ammonium oxalate. This precipitate contains no iron or aluminum, and can be washed free from ammonium oxalate, dissolved, and oxidized with standard potassium permanganate solution. The entire analysis may be completed in from 15 to 20 minutes.

GEOLOGICAL AND MINERALOGICAL CHEMISTRY.

M. L. FULLER, REVIEWER.

Some Analyses of Italian Volcanic Rocks, II. BY HENRY S. WASHINGTON. *Am. J. Sci.*, 159, 44–54.—1. Ciminitite. From a trachytic flow at Monte Cimino, Viterbo. The mineral components of this rock as computed from the analyses are orthoclase 37.9 per cent., labradorite 26.5, diopside 16.5, olivine 17.3, and magnetite 1.8. This would place the rock between the trachytes and the andesites and basalts in the group of andesitic trachytes or trachydiorites of Rosenbusch (latite of Ransome). 2. Selagite. This is a lamprophyric latite occurring as a volcanic neck in Tertiary marls, Monte Catini, Tuscany. The analyses

are almost identical with those of ciminite, though the diverse conditions of consolidation have resulted in the formation of a different set of minerals; the selagite carrying less olivine, orthoclase, and a plagioclase of less lime, but containing at the same time more augite and an abundance of biotite. It affords a good illustration of the tendency of the complex biotite molecule to crystallize as biotite in intrusions while it splits up into olivine, orthoclase, leucite, etc., in extrusions. Compared with biotite-vulsinite, selagite shows the additional presence of olivine, the available supply of MgO in the magma of the former being exhausted by the crystallization of the biotite and augite. The chemical relations of selagite to venanzite, madupite, wyomingite, and orendite are also discussed. 3. Andesite. From a volcanic neck in Pliocene marls, Radicofani, Tuscany. The new analyses lead the author to consider the rocks examined as basic andesites rather than ciminities, as he has previously held. 4. Leucitite. From a surface flow at Capo di Bove, Alban Hills. Calculations based upon the analyses, aided by physical examination, give the probable mineral composition as leucite 52 per cent., nephelite 10, melilite 17, diopside 17, and magnetite 4. Comparison is made between the composition of the leucitite in question and that of Bearpaw Mt., Montana, and also with venanzite.

Mineral Resources of the Province of New Brunswick. By L. W. BAILEY. *Geol. Surv., Canada, Ann. Rep.*, 10, Part M, 1-128.—In addition to exhaustive statistics, some twenty analyses, including magnetite, graphite, limestone, gypsum, mineral waters, and ores of antimony and manganese, are given.

Annual Report for Section of Mineral Statistics and Mines. By E. D. INGALL. *Geol. Surv., Canada, Ann. Rep.*, 10, Part S, 1-230.—A considerable portion of the report is devoted to the iron ores. Ten analyses of the chromic iron ores of Quebec, and over 150 analyses of the Nova Scotia ores, are given. Of the latter, some 50 are published for the first time.

Illinois Gulch Meteorite. By H. L. PRESTON. *Am. J. Sci.*, 159, 201-202.—This meteorite was found some 4 feet below the surface in Deer Lodge County, Montana, and measured $63 \times 104 \times 105$ mm. A physical examination showed the presence of troilite and a dark steel-gray crystalline mineral supposed to be rhabdite. The analysis of the ground mass showed the presence of 92.51 per cent. of iron, 6.70 per cent. of nickel, and small amounts of cobalt, phosphorus, carbon, and silica.

Granodiorite and Other Intermediate Rocks. By WALDEMAR LINDGREN. *Am. J. Sci.*, 159, 269-282.—This paper has

in view the fixing of the position of granodiorite in relation to allied granitic rocks. A somewhat detailed consideration of its chemical and mineralogical composition is given, accompanied by a discussion of its relations to granite, diorite, monzonite, tonalite, banatite, etc. The conclusions reached are that the granodiorite is to be considered as a granular rock with, perhaps, an average composition of quartz 23 per cent., soda-lime feldspars 44 per cent., alkali feldspars 8 to 20 per cent., and ferro-magnesian silicates 14 per cent. The family is regarded as being clearly defined, and is of wide distribution along the Pacific slopes of the Cordilleran ranges.

Two New American Meteorites. BY H. L. PRESTON. *Am. J. Sci.*, 159, 283-286.—The first of the meteorites described was found at Luis Lopez, New Mexico, and weighed 6.9 kilograms. The sections showed nodules of troilite, streaks and seams of troilite and schreibersite, and rhomboidal patches of plessite composed of alternating layers of kamacite and t̄enite. The surface was covered with a somewhat lustrous reddish brown crust and was deeply pitted. The analysis showed 91.312 per cent. of Fe, 8.170 per cent. of Ni, and small amounts of Co, P, S, and C. The second of the meteorites, which came from central Missouri, probably weighed about 25 kilograms and is of the same general character as the preceding. The analysis differed from the former in having some 3.42 per cent. more iron and 3.55 per cent. less nickel, the other constituents being nearly the same in both.

Coal Analyses. BY GEORGE HALL ASHLEY. *Dept. Geol. and Natural Resources of Indiana, Ann. Rep.*, 23, 1565-1573.

Geology of Story County, Iowa. BY S. W. BEYER. *Iowa Geol. Surv., Ann. Rep.*, 9, 155-237.—Sanitary and chemical analyses, together with the probable mineral combinations, are given for certain of the artesian waters occurring in the county.

Geology of Scott County, Iowa. BY W. H. NORTON. *Iowa Geol. Surv., Ann. Rep.*, 9, 389-519.—Several analyses of artesian waters from the Galena, Saint Peter, and underlying formations are included in this report.

Artesian Wells of the Belle Plaine Area, Iowa. BY H. R. MOSNAT. *Iowa Geol. Surv., Ann. Rep.*, 9, 521-562.—The discussion is mainly geological but a number of analyses are given.

Minnesota Iron Mining Economically and Statistically Considered. BY HORACE V. WINCHELL. *Minn. Geol. Surv., Final Rep.*, 4, 581-616.—Some 200 analyses of the Lake Superior iron ores for 1898 and 1899 are given. Of these the Gogebic range

furnished about 40, Menominee range 40, Marquette 65, Mesabi 45, and Vermilion range 10.

Ore-bearing Schists of Middle and Northern Cape Breton.

BY J. EDMUND WOODMAN. *Dept. Mines, Nova Scotia, Rep.* 1898, 1-39.—In addition to the description of the ore-bearing schists, the author discusses briefly the question of the origin of the metalliferous minerals, which he regards in general as due to solfataric action.

Coal in Lower Michigan. BY ALFRED C. LANE. *Mich. Miner*,

1, Nos. 3-10.—This paper is a semi-popular, but thoroughly scientific discussion of the origin, occurrence, erosion, disturbance, and economic development of coal in Lower Michigan. In an appendix there are descriptions of the methods of both proximate and ultimate analyses of coals and of the analysis of ash, together with a discussion of the determination of the heating power, both directly and from proximate analyses.

Magmatic Differentiation in the Rocks of the Copper-bearing Series.

BY ALFRED C. LANE. *Bull. Geol. Soc. Am.*, 10, 15-18.—This paper treats of the chemical and mineralogical variations in the effusive flows constituting the copper-bearing rocks of the Lake Superior region, and discusses their causes. A number of analyses of the upper and lower parts of the flows, and of normal and quartziferous basic intrusives are given.

Formation of Dikes and Veins. BY N. S. SHALER. *Bull.*

Geol. Soc. Am., 10, 253-262.—1. Dikes. The author divides dikes into (1) those which have followed preexisting joints or bedding planes, and (2) those which have burrowed their way through the rock independently of fracture lines. The many cases in which the former have apparently followed the lines of more difficult rather than those of less difficult passage leads him to reject hydrostatic pressure as the principal cause of the penetration of the molten material. The conclusions reached are that the sudden conversion of the water of the fissures into steam by contact with the molten material of the dike is the true explanation of the opening of the passage ways for the latter. The passages for the material of dikes of the second class are considered to have resulted from the progressive melting and absorption of the walls by the advancing magma. 2. Veins. The author considers that open fissures could not exist at the depths at which ordinary veins were probably formed, but regards the filling as the result of lateral secretion, the walls being pressed backward by the expansive force of crystallization. Veins of this nature, although apparently presented by the author as a new type, belong to a well-recognized class of deposits. Few would agree

with the author, however, in going to the extreme of referring so large a proportion of veins to an origin by lateral secretion.

Physiography and Geology of the Region Adjacent to the Nicaragua Canal Route. BY C. WILLARD HAYES. *Bull. Geol. Soc. Am.*, 10, 285-348.—One of the most conspicuous and important of the geological features along the canal route is the rock decay. The types prevailing on the opposite side of the isthmus are widely different, and are the natural result of the climatic conditions. In the Eastern Division there is a heavy rainfall distributed throughout the year, the surface is covered by dense forests, and the soil and rock are thoroughly saturated with water. As a result, the decomposition extends to great depths. The resulting soils present a deep red color near the surface, but graduate downward, first through a blue clay, then through the soft rock (saprolite), and finally into the undecomposed rock at the bottom. In the Western Division the wet and dry seasons alternate. During the dry season numerous cracks are formed in the soil by shrinkage. Into these cracks a considerable quantity of vegetable matter finds its way, and, upon the return of the wet season and the closing of the cracks, is incorporated in the soil, where its action is to prevent the oxidation of the iron. The result is that the red colors so characteristic of the Eastern Division are entirely wanting. The rate of weathering is much slower than in the Eastern Division.

Notes on the Drift of Northwestern Iowa. BY H. F. BAIN. *Am. Geol.*, 23, 168-176.—In connection with attempts to discriminate between the Kansan and the younger glacial deposits, a study was made of the chemical weathering of the drift. Both the older and the younger drifts were derived largely from limestone rocks, but in the older all traces of lime have now been removed by solution, leaving a siliceous, iron-stained mass behind. The difference is sufficiently general to be of value in the correlation of the various Kansan exposures.

Notes on the Cretaceous and Associated Clays of Middle Georgia. BY GEORGE F. LADD. *Am. Geol.*, 23, 240-249.—The various Cretaceous and Tertiary clays of the Coastal Plain are described, and a number of chemical and mineralogical analyses made by the author are given.

Origin and Age of Certain Gold "Pocket" Deposits in Northern California. BY O. H. HERSHEY. *Am. Geol.*, 24, 38-43.—The deposits in question are located in Trinity County and vicinity, and occur in a black slate of Jurassic age, which is known locally as "porphyry." Underlying the slates is a great mass of diabase in which the gold often assays as high as \$2 or

\$3 a ton. During Carboniferous times this mass was exposed to the atmospheric agencies and was deeply eroded by subærial denudation, the insoluble gold accumulating in the resulting soil, especially in the depressions or pockets. During the subsequent subsidence and advance of the sea the gold is assumed to have been further concentrated in the depressions, where it was finally covered by the deposits of slate. The author explains the coarse condition of the gold in the pockets as compared with that in the veins and amygdules as probably due to the combination of many separate grains through fusion, brought about by the friction, etc., accompanying the metamorphism of portions of the slate.

The Gold-bearing Formation of Stephenson County, Ill. BY OSCAR H. HERSHEY. *Am. Geol.*, 24, 240-244.—The gold, which is not present in economic quantities, occurs as impregnations in one or more strata of the Utica series. The author considers the material to have been in a finely divided and disseminated state in the same or closely adjacent strata, and to have been afterwards concentrated through the agency of solutions traversing the strata laterally.

A Discussion of the Use of the Terms Rock-weathering, Serpentinization, and Hydrometamorphism. BY GEO. P. MERRILL. *Am. Geol.*, 24, 244-250.

Notes on the Corundum-bearing Rocks of Eastern Ontario, Canada. BY WILLET G. MILLER. *Am. Geol.*, 24, 276-282.—The corundum occurs in four different igneous rocks: syenite, syenite pegmatite, nepheline syenite, and anorthosyte. A number of analyses of the anorthosyte, one of which is new, and new analyses of bytownite and hornblende are given.

Some Further Notes on the Weathering of Diabase in the Vicinity of Chatham, Virginia. BY THOMAS L. WATSON. *Am. Geol.*, 24, 355-369.—The paper presents the results of a careful study of the nature and results of the weathering of diabase. A considerable number of analyses of both fresh and decomposed rocks are given. The tabulated results show a loss in weathering of from 14.93 per cent. (diabase from Medford, Mass.) to 70.31 (olivine diabase from Chatham, Va.). In the decomposition of the Chatham diabase, iron is the constant factor, the alumina which is often selected as the factor, showing in this case a distinct loss.

The Blue Mound Quartzite. BY GEO. D. HUBBARD. *Am. Geol.*, 25, 163-168.—This quartzite occurs as a capping on Blue and East Mounds, in Iowa and Dane Counties, Wisconsin, and

is probably to be regarded as a remnant of a stratum once continuous over most of the southwestern portion of the state. The author considers the stratum to be the remnant of a highly siliceous Niagara limestone, the calcareous matter of which has been removed by solution, the silica at the same time being deposited in the compact form which it now presents.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

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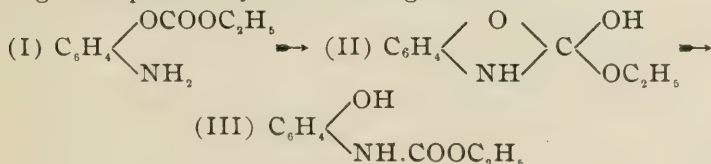
ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

ORGANIC CHEMISTRY.

J. F. NORRIS, REVIEWER.

On the Molecular Rearrangement of *o*-Aminophenylethyl Carbonate to *o*-Oxyphenylurethane. BY JAMES H. RANSOM. *Am. Chem. J.*, 23, 1-50.—When *o*-nitrophenylethyl carbonate is reduced in alcoholic solution with tin and hydrochloric acid, a white crystalline compound is obtained, which melts at 86° and not at 95° as given by Bender (*Ber.*, 19, 2268). As the compound is insoluble in acids, it seemed probable that the constitution which had been assigned to it, aminophenylethyl carbonate, was incorrect. The author, accordingly, undertook a thorough investigation of the reaction, and has shown that Bender's compound is identical with *o*-oxyphenylurethane prepared from *o*-aminophenol and ethyl chlorformate. By effecting the reduction of the nitro compound at a low temperature, an oil, soluble in acids, was obtained, which proved to be *o*-aminophenylethyl carbonate. This compound readily suffered rearrangement into *o*-oxyphenylurethane. This change was studied carefully, as it seemed probable that an intermediate product was formed in the reaction. This compound would be of interest on account of the fact that it could be an addition-product of an amine and an ester, and would, therefore, throw light on the reaction between compounds of these classes. The change is expressed by the following formulae:



Formula (II) represents the constitution of the hydroxide base corresponding to the hydrochloride of ethoxymethenylaminophenol (an imido ester), if the salts of the imido esters are formed by the addition of the acid to the double bond between the carbon and nitrogen atoms. The isolation of such a compound would be of value in deciding the structure of such salts. The compound was not obtained, but the author is of the opinion that it was formed during the transformation for the following reasons: *p*-aminophenyl carbonate was found to be a perfectly stable compound, the rearrangement being peculiar to the ortho series, and, further, the rearrangement occurs only as long as the nitrogen atom holds at least one hydrogen atom. In order to determine whether the structure of the compound formed by the reduction of *o*-nitrophenylethyl carbonate is represented by formula (II) or formula (III), the action of acyl chlorides on it was studied. By the action of benzoyl chloride, a compound was readily obtained, which was identical with the substance formed by the action of ethyl chlorformate on benzoyl-*o*-aminophenol. This fact indicates that the benzoyl ester is a derivative of a substance of formula (II), but since a molecular rearrangement of aminoethylphenyl carbonate was proved, the structure was investigated from another point of view. The benzoyl ester of oxyphenylurethane is insoluble in alkalies, and has the ring structure. If the methyl ester has an analogous structure, it should exhibit the same reactions. The methyl ether was prepared from methylaminophenol and ethyl chlorformate, and also from oxyphenylurethane by direct methylation by means of diazomethane. The ester was soluble in alkalies, and was, accordingly, a derivative of a compound of formula (III). Since it has been shown that diazomethane can be used to determine delicate questions of constitution, the methyl group being introduced with such ease, it follows that formula (III) represents the structure of the compound formed from *o*-nitrophenylethyl carbonate by reduction. A careful study of the relation between the ring compound (formula II) and the hydrochloride of ethoxymethenylaminophenol was not made, but it was shown that the salt gives by hydrolysis oxyphenylurethane under the same conditions that aminophenylethyl carbonate does. This reaction is further evidence in favor of the view of the structure of the salts of imido ethers put forward by Stieglitz (*Am. Chem. J.*, **21**, 108). Benzoyloxyphenylurethane (m. p. 75°.5) was prepared from benzoylchloride and oxyphenylurethane, and also from benzoyl-*o*-aminophenol and ethylchlorformate. It is insoluble in acids and alkalies, can be saponified, and yields, on dry distillation, alcohol, benzoylaminophenol, ethylbenzoate, and benzoyl carbonyl-*o*-aminophenol. The latter compound (m. p. 174°) was also prepared from carbonylaminophenol. Analogous compounds

containing the nitrobenzoyl group were prepared. Carbethoxy-aminophenolphenyl carbamate, prepared from the phenol, phenyl isocyanate, and aluminum chloride melts at 116° – 118° . Carbonylmethyl-*o*-aminophenol, $\text{CH}_3\text{N.C}_6\text{H}_4\text{OCO}$, was prepared

from the phenol and methyl iodide. It melts at 86° , and when heated with concentrated hydrochloric acid at 180° , yields *o*-methylaminophenol (m. p. 88° – 90°) which with benzoyl chloride forms an ester (m. p. 160° – 162°), and with ethyl chlorformate gives benzoylmethyl-*o*-aminophenylethyl carbonate (m. p. 68°). *o*-Oxyphenylmethylurethane, prepared from methyl-*o*-aminophenol and ethyl chlorformate, melts at 53° and yields a benzoyl derivative which melts at 88° – 90° . From anisidine and ethyl chlorformate, *o*-methoxyphenylurethane (b. p. 180 – 182° at 26 mm.) was prepared. By bromination a monobrom derivative (m. p. $102^{\circ}.5$) and a compound melting at 252° were formed. By the action of phosphorus pentachloride, a chloride was obtained, which was converted into *o*-anisidine urea (m. p. 143° – 145) by ammonia, and into the corresponding phenyl derivative (m. p. 144°) by aniline. *o*-Aminophenylethyl carbonate is an oil, and forms a hydrochloride (m. p. 150° – 152°), which forms a double salt with platinum chloride. *p*-Nitrophenylethyl carbonate melts at 68° and is converted into an amido compound (m. p. 36°) on reduction, which gives a hydrochloride (m. p. 197°) and a double chloride containing platinum (m. p. 237°). *p*-Aminophenylethyl carbonate was converted into the corresponding urea (m. p. 147° – 150°), but a transformation similar to that which took place with the ortho compound could not be brought about.

Products of the Explosion of Acetylene. BY W. G. MIXTER. *Am. J. Sci.*, 159, 1–9.—The explosion of acetylene was studied in order to test the hypothesis advanced by the author, that a sufficient frequency of molecular impacts is requisite to secure spread of explosive change throughout a gas. The gas was introduced into glass tubes 20 cm. long and 11–15 mm. internal diameter at ordinary temperature and pressure. The tubes were then sealed and heated in a furnace. When the desired temperature was reached, the gas was exploded by an electric spark produced between platinum wires sealed in the tubes. In no case was the explosion violent. The hydrogen remaining after absorbing acetylene was the measure of the decomposition; the difference between the volume of acetylene taken and the volume of gas after explosion was considered a measure of the condensation-products formed. As the result of fifteen experiments it was shown that at 325° , decomposition did not extend throughout the gas, although the energy of the system was greater than

that containing twice as many molecules at 0° in the same space—a condition in which decomposition will propagate itself. At temperatures above 325° the decomposition was self-propagating, as the impacts were of sufficient frequency to cause explosion. The results at high temperatures present the striking fact that the amount of acetylene decomposed, as measured by the residual hydrogen, is fairly constant from 350° to 450° . At 447° 50 per cent. of the acetylene was decomposed and 20 per cent. was condensed. When acetylene was exploded under conditions allowing expansion, in a tube 10 mm. in diameter, at the temperature of the room, and under a pressure of 3 atmospheres, the explosion was violent and 79 per cent. of the gas was decomposed and 5 per cent. was condensed. When the explosion took place in a bomb where no change in volume was possible, the residual acetylene amounted to almost 4 per cent. The decomposition into carbon and hydrogen in this case was probably complete. The acetylene present after the explosion was no doubt formed from its elements at the high temperature reached in the decomposition. In the experiments in which the acetylene contained a trace of air, the presence of hydrocyanic acid was noted.

Camphoric Acid. BY WILLIAM A. NOYES. *Am. Chem. J.*, 23, 128-135.—The author suspected that the ketone prepared from dihydrociscampholytic acid (*this Rev.*, 5, 127) was 2,3,3-trimethylcyclopentanone, and, accordingly, undertook the preparation of the latter compound by a synthesis which would leave no doubt as to its structure. This synthesis has been completed with the result that the two compounds are proved to be identical. It follows from this fact that ciscampholytic acid is Δ^1 -2,3,3-trimethylcyclopentenoic acid, and that the older formula of Perkins for camphoric acid and Bouveault's formula for camphor are correct. γ -Bromisocaproic acid was condensed with the sodium derivative of methylmalonic ester. From the resulting ester of 2,3,3-tetramethylhexoic 1,2¹,6-acid (b. p. 180° – 187° at 20 mm. pressure) the free acid $(\text{HOOC})_2\text{C}(\text{CH}_3)_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{COOH}$ was prepared, which crystallizes from ether in needles, which begin to decompose at 175° and give a quantitative yield of $\alpha\beta$ -trimethyladipic acid when heated at 190° – 200° . The trimethyladipic acid, when distilled from lime, was converted into a ketone which yielded an oxime (m. p. 104°) identical with the one from the ketone prepared from α -hydroxydihydrociscampholytic acid. The author gives his reasons for his opinion that camphonic acid is a normal γ -lactone.

On the Rearrangement of Imido-esters. BY HENRY L. WHEELER, TREAT B. JOHNSON, MUNSON D. ATWATER, AND

BAYARD BARNES. *Am. Chem. J.*, 23, 135-150.—A distinct part of the work described in this article was done by each of the four authors. In this review a separate paragraph, preceded by the author's initials, is devoted to the work of each.

H. L. W.—Imidoesters react slowly at ordinary temperatures with methyl and ethyl iodides, giving alkylamides. This reaction is accompanied by the formation of hydrogen iodide, which with unaltered ester gives a primary amide, and by a decomposition of part of the ester into nitril and alcohol. The products identified as the result of the action of methyl iodide on benzimidoethyl ester were methylbenzamide, benzamide, benzonitril, and a trace of cyanphenin. The result was the same at room temperature or at 100° , and in the presence of a small or large amount of methyl iodide. Ethyl iodide gave a similar result. A search was made for diethylbenzamide in the reaction-product, but without success. Benzimidoisobutyl ester and methyl iodide gave isobutyl iodide and methylbenzamide. Benzimidoisobutyl ester and isobutyl iodide gave benzonitril, benzamide, and isobutylene. In order to determine the properties of isobutylbenzamide, which was expected as a product of the above reaction, it was prepared by the Baumann-Schotten reaction, and found to be an oil which boiled at 173° - 178° at 13 mm. pressure and formed crystals which melted at 57° - 58° .

T. B. J.—A quantitative study of the reaction between phenylacetimidomethyl ester and methyl iodide showed that the amount of transformation taking place was independent of the quantity of methyl iodide used. The weights of phenylacetamide, phenylacetanitril, and methylphenylacetamide from 20 grams of the imidoester were approximately 2, 4, and 6 grams, respectively. Ethylphenylacetamide crystallizes from water in colorless plates, which melt at 73° - 74° .

M. D. A.—Furimidomethylester was prepared from furyl cyanide; it boils at 52° - 57° at 8 mm. and at 169° - 172° at 762 mm. pressure. The behavior of this ester with methyl iodide is analogous to that of the other imidoesters. Methylpyromucamide, prepared by this reaction, melts at 64° . *p*-Tolenylimidomethylester (b. p. $105^{\circ}.5$ at 10.5 mm. pressure) suffered a transformation with methyl iodide similar to those described above. β -Naphthylimidoethylester was also prepared, and showed a similar reaction with ethyl iodide.

B. B.—Experiments with silver succinimide and methyl and ethyl iodides showed that the oxygen esters, which are first formed as products of the reaction, are converted by the alkylhalide into nitrogen esters. The results are therefore in accord with the facts described above. As an example of an acylimido ester benzoylbenzimidioester was studied. This compound suf-

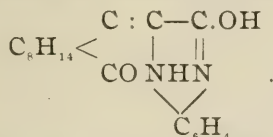
ferred no transformation with ethyl iodide, but when heated to 200° was decomposed into benzonitril and ethylbenzoate.

Anethol and Its Isomers. By W. R. ORNDORFF AND D. A. MORTON. *Am. Chem. J.*, 23, 181-202.—The authors have subjected the work on anethol and fluid metanethol to a careful revision and find that the two substances are identical. In odor, taste, boiling-point ($233^{\circ}.5$), melting-point ($22^{\circ}.5$), specific gravity, and crystal form, the pure products exhibit no differences. Both substances show exactly the same chemical conduct. They yield the same dibromide (m. p. 63° - 64°), monobrom dibromide (m. p. 102°), hydrochloride, picrate (m. p. about 70°), nitrosite (m. p. 130°), nitrosite anhydride (m. p. 98°), and nitrosochloride (m. p. 123°). A compound of the formula $C_{10}H_{12}O.C_2H_5OH$ is formed by the action of alcoholic potash on anethol hydrochloride. The compound is a liquid, which distills with steam with slight decomposition. When distilled alone it breaks down completely yielding alcohol, anethol, and higher-boiling products. Anethol gives a hydrobromide analogous to the hydrochloride. When decomposed by alcoholic potash and distilled, it yields, as chief products, anethol and isoanethol. When an alcoholic solution of anethol was treated with sodium, *p*-propylanisol was formed. Anethol is rapidly and completely converted into anisoin when it is heated in acetone solution with iodine. *p*-Cresol was isolated as one of the products of the destructive distillation of anisoin.

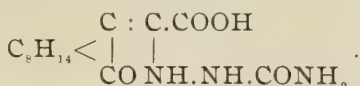
Condensation Compounds of Amines and Camphoroxalic Acid. By J. BISHOP TINGLE AND ALFRED TINGLE. *Am. Chem. J.*, 23, 214-230.—In a previous paper (*this Rev.*, 5, 67) the authors described the action of aniline on camphoroxalic acid. The work has been extended to the study of the action of other amines on the acid, and the results show that the products of the reaction when fatty amines are used are not analogous in structure to those obtained from aromatic amines. This difference in behavior is probably due to the great difference in basicity of the two classes of amines. In the present paper the action of α - and β -naphthylamine, *o*-phenylenediamine, and semicarbazide on camphoroxalic acid is described. By the action of α -naphthylamine on the acid, in alcoholic solution at 100° , a compound was obtained which crystallizes from benzene in amber-colored crystals, and melts at 170° with decomposition. The compound resembles the aniline derivative prepared in an analogous way and probably has the following structure:



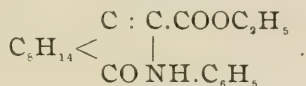
β -Naphthylamine gives a similar compound (m. p. 173°). *o*-Phenylenediamine readily condenses with the sodium salt or ethyl ester of camphoroxalic acid giving a compound (m. p. 246°) to which the following structure is assigned:



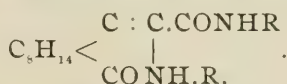
Two substances are formed by the interaction of semicarbazide and potassium camphoroxalate in presence of alcohol at 100° . They are separated by their different solubilities in ether. The soluble compound melts at 218° , the insoluble at 209° – 210° . Both have the composition represented by formula



At 100° , in alcoholic solution, ethyl camphoroxalate and aniline yield the compound (m. p. 158° – 160°)



Compounds of an analogous composition were obtained from β -naphthylamine (m. p. with decomposition at 174°) and from semicarbazide (m. p. 202°). Ethylcamphoroxalate condenses with ammonia, methylamine, and ethylamine under similar conditions, but the compounds formed have the following structure:



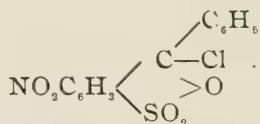
These substances will be described in a later paper. Condensation-products could not be obtained from the ester or salt of camphoroxalic acid and ethylaniline, dimethylaniline, *m*- and *p*-phenylenediamine, or urea. Ethylcamphoroxalate did not react with α -naphthylamine or dimethylaniline. Phenylcamphoromeneamine,



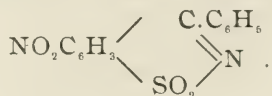
readily reacts with acid chlorides. The benzoyl derivative melts at 160° – 161° , the benzenesulphonyl compound at 133° , and the acetyl derivative, which was not obtained in pure condition, at 134° . The formation of acyl derivatives is evidence in favor of the

view of the structure of the compound represented by the above formula.

The Symmetrical Chloride of Paranitroorthosulphobenzoic Acid. BY F. S. HOLLIS. *Am. Chem. J.*, 23, 233-255.—The author gives much improved directions for the preparation of the chlorides of *p*-nitro-*o*-sulphobenzoic acid. By regulating the conditions under which the acid potassium salt of the acid is treated with phosphorus pentachloride, the resulting product consists of the unsymmetrical chloride only, or of a mixture of the chlorides, which contains 30-40 per cent. of the symmetrical chloride. The two chlorides were separated by crystallization from chloroform. The action of benzene and aluminum chloride on the two chlorides was studied under a variety of conditions. Both compounds yielded the same product, *p*-nitro-*o*-benzoylbenzenesulphone chloride, but one chlorine atom entering into the reaction. The compound crystallizes in monoclinic crystals, and melts at 177°. The author is of the opinion that the chloride has the structure represented by the following formula on account of its high melting-point and the fact that it is not acted upon by alcoholic potash:



By heating with hydrochloric acid, sulphuric acid, water, or absolute alcohol, the chloride is converted into *p*-nitro-*o*-benzoylbenzenesulphonic acid. The barium salt of this acid is of interest, as it crystallizes with three, three and one-half, six, and seven molecules of water of crystallization. The sodium, potassium, magnesium, calcium, and lead salts were also prepared. *p*-Nitro-*o*-benzoylbenzenesulphone chloride, when heated with concentrated ammonia at 100°, gave a lactim of the formula,



The compound is a granular powder (m. p. 234°), which is converted into the ammonium salt of nitrobenzoylbenzenesulphonic acid when heated with hydrochloric acid at 200°.

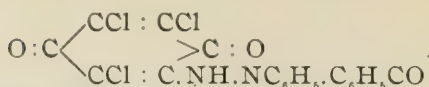
Stereoisomers and Racemic Compounds. BY HERMAN C. COOPER. *Am. Chem. J.*, 23, 255-261.—Kipping and Pope (*Proc. Chem. Soc.*, 1898, 113) have shown that on allowing a racemic mixture to crystallize from an optically active solvent, the first fractions show a preponderance of crystals of one of the

isomers. This fact would indicate that the optical isomers had different solubilities in the solvent, but since the author with Goldschmidt (*Ztschr. phys. Chem.*, 26, 711) had found that the two active carvoximes have the same solubility in *d*-limonene, it seemed of interest to investigate the subject further. The sodium ammonium tartrates, the compounds investigated by Kipping and Pope, have the same solubilities in dextrose solutions of varying strength, notwithstanding the fact that they can be separated by crystallization from such solutions. The sodium hydrogen tartrates were investigated with the same result. Sodium hydrogen tartrate decomposes at 234° , the racemate at 219° , and a mixture of equal parts of the optical isomers at 222° . A mixture of approximately equal parts of the active carvoximes melts at 93° , the melting-point of inactive carvoximes. A slight shrinking was observed at 72° , the melting-point of the active body. On mixing equal amounts of the active sodium hydrogen tartrates in water, a cloudy precipitate of racemate appears and does not disappear until the temperature of solution of the racemate is reached. A mixture of the active carvoximes has the same solubility in aqueous alcohol as the inactive variety.

A New Synthesis in the Quinazoline Group. BY MARSTON TAYLOR BOGERT AND AUGUST HENRY GOTTHELF. *J. Am. Chem. Soc.*, 22, 129-132.—When anthranilic acid was heated in a sealed tube with acetonitrile, 2-methyl-4-ketodihydroquinazoline was obtained. In this preliminary paper the authors show that this is a general reaction by preparing analogous derivatives from the nitriles of propionic, benzoic, phenylacetic, and *p*-toluic acids. The yields are good, and as the reaction proceeds as readily with aromatic as with fatty nitriles, the synthesis will be of particular value in preparing quinazoline derivatives containing aromatic groups.

A Comparison of Some Formaldehyde Tests. BY B. M. PILHASHY. *J. Am. Chem. Soc.*, 22, 132-136.—The author reports the results of a study of the various tests for formaldehyde. It is shown that the test of Trillat with dimethylaniline and sulphuric acid is untrustworthy, since the amine itself gives the color reaction which is said to be due to the aldehyde. The author concludes that phenylhydrazine hydrochloride is the best reagent for detecting formaldehyde.

The Action of α -Acylation Phenylhydrazines on the Chlorine Derivatives of Quinones. BY WILLIAM MCPHERSON AND ROBERT FISCHER. *J. Am. Chem. Soc.*, 22, 141-144.—Trichloroquinone reacts readily with unsymmetrical benzoylphenylhydrazine and forms a compound of the structure,



The two atoms of hydrogen which are removed in the condensation, reduce a part of the quinone to the corresponding hydroquinone. This reaction is of interest since hydrazones are formed from quinone and acylated phenylhydrazines. The new compound is a bright red crystalline body which melts at $158^{\circ}.$

On the Action of Certain Acid Reagents on the Substituted Ureas. BY F. B. DAINS. *J. Am. Chem. Soc.*, 22, 181-198.—The action of a number of acids, acid chlorides, and acid anhydrides on substituted ureas was studied, and in no case was the direct introduction of an acyl group observed. In all cases the temperature required to produce reaction was so high that acyl ureas were never isolated, but only their decomposition-products. The experiments presented show that the reaction between thioureas and organic monobasic acids gives fairly constant results, the products being carbon dioxide, hydrogen sulphide, water, aniline, the anilide, mustard oil, and carbanilide. With dibasic acids and acid chlorides the reaction is more complicated and varied. Reference must be made to the original paper for the large number of details given.

The History of the Constitution of the Alkaloids. BY A. R. L. DOHME. *Am. J. Pharm.*, 72, 9-25.

Racemism. BY ROBERT HART BRADBURY. *J. Franklin Inst.*, 149, 299-314.—A historical lecture.

BIOLOGICAL CHEMISTRY.

A. G. WOODMAN, REVIEWER.

Preliminary Communication on the Chemistry of Mucin. BY P. A. LEVENE. *J. Am. Chem. Soc.*, 22, 80-85.—The author has obtained a substance with acid properties from tendomucin, submaxillary mucin, and a mucoid carcinoma. Its chemical properties, as well as the analysis of its copper salt, point to its identity with chondroitinsulphuric acid. The results of this preliminary investigation seem to show that the mucins in general are not simple compounds of proteids and carbohydrates, but are proteid derivatives of an ethereal sulphuric acid.

On the Maximum Production of Hippuric Acid in Rabbits. BY W. H. PARKER AND GRAHAM LUSK. *Am. J. Physiol.*, 3, 472-484.—The authors conclude that in metabolism the proteid molecule, the same being likewise true of gelatine, may yield

glycocoll to the extent of 3 or 4 per cent., the amount of hippuric acid found being taken as a measure of the formation of glycocoll. The carbohydrates do not increase the formation of glycocoll. Details are given of an improved method for the determination of hippuric acid in urine.

On the Metabolism of Matter in the Living Body. BY EDWARD B. ROSA. *Phys. Rev.*, 10, 129-150.—The author has calculated the balance of oxygen and of matter for a four-days' metabolism experiment made with a respiration calorimeter (*this Rev.*, 6, 104). The change in weight of the subject during the 96 hours, which was observed as a check upon the calculations, is shown by graphical representations. Suggestions are also made for an improved method for obtaining the weight of the subject by means of outside observations.

Dietary Studies of Negroes in Eastern Virginia in 1897 and 1898. BY H. B. FRISSELL AND ISABEL BEVIER. *U. S. Dept. Agr., Bull.* 71, 1-45.—As a result of these investigations it was found that in the negro families which had come under the influence of educational institutions, such as Hampton and Tuskegee, the diet resembled quite closely that of the ordinary white family under similar conditions. In the other cases studied, the difference was not so much in the amount of nutritive material as in the manner of preparing and serving it. No analyses of food materials are given, the composition being estimated from tables previously published.

Dietary Studies of University Boat Crews. BY W. O. ATWATER AND A. P. BRYANT. *U. S. Dept. Agr. Expt. Sta. Bull.*, 75, 1-72.—These studies further emphasize the large amount of energy in the dietaries of athletes and the striking difference in the amounts of protein consumed by them and by ordinary working people. A comparison between the dietaries of the boat crews and the average of fifteen college clubs showed a difference in protein amounting to four and a half times the difference in fuel value. The results tend to confirm the view that men or animals who perform intense muscular work for short periods of time, under more or less nervous strain as well, require a larger supply of protein than under normal conditions of slow, long continued work. It is a question, however, whether under these "normal" conditions a part of the energy is not supplied by fat rather than by protein.

Character and Extent of Food and Drug Adulteration in Massachusetts, and the System of Inspection of the State Board of Health. BY ALBERT E. LEACH. *Tech. Quart.*, 13, 22-40.—This article, which does not admit of a brief review, is

a rather popular discussion of the extent of adulteration in Massachusetts and of the kind of substances usually adulterated.

Soil Investigations. BY HARRY SNYDER. *Minn. Agr. Expt. Sta. Bull.*, 65, 1-84.—This bulletin contains a discussion of the chemical and mechanical composition of certain Minnesota soils, together with an outline of their characteristic features and the measures which the author considers necessary to preserve their fertility.

The Proteids of Wheat Flour. BY HARRY SNYDER. *Minn. Agr. Expt. Sta. Bull.*, 63, 519-533.—The author has made a study of the proteids of a number of samples of flour and mill products, following the methods proposed by Osborne and Voorhees (*Am. Chem. J.*, 15, 392), for the separation of the proteids. Among other observations it was found that while the lower grades of flour contain more protein than the high grades, the gliadin and glutenin in the lower grades are not present in the right proportion to form a well-balanced gluten; that is, one which will produce bread of the best physical properties. The gliadin-glutenin ratio in different grades of flour made from the same wheat was found to vary from 25 to 75 in the red dog or lowest grade, to 65 to 35 in the highest. A well-balanced gluten is considered to have this ratio approximately as 65 to 35.

Winter vs. Spring Bran. BY WILLIAM FREAR AND W. A. HUTCHINSON. *Pa. State Coll. Agr. Expt. Sta. Bull.*, 48, 1-8.—The analysis of twenty samples shows that the average spring wheat bran is drier than winter wheat bran and contains less starchy matter and appreciably more protein and fat, as well as ash and fiber.

The Feeding Value of Sorghum as Shown by Chemical Analysis. BY R. W. THATCHER. *Nebr. Agr. Expt. Sta. Bull.*, 62, 65-72.—Experimental tests have shown that sorghum possesses different feeding values at different stages of growth. A series of analyses made to find the reason for this show that when the plant is young it is deficient in flesh-forming material, being about the same as timothy. An interesting point is the apparent absence of sugar when the seed is sown broadcast instead of in rows.

A Chemical Study of the Apple and Its Products. BY C. A. BROWNE, JR. *Pa. Dept. Agr. Bull.*, 58, 1-46.—In this bulletin the author discusses the chemical composition of the apple, the chemistry of its growth and ripening, and the effect of storage. A further discussion is also given of the principal apple products, including evaporated apples, cider, jelly, apple butter, apple

pomace, and vinegar. A short bibliography of the most important books relating to the subject is appended.

Experiments with Potatoes. BY CHAS. D. WOODS AND J. M. BARTLETT. *Me. Agr. Expt. Sta. Bull.*, 57, 145-158.—Experiments have been made with regard to the effect upon the starch content of potatoes of spraying them with Bordeaux mixture. The average amount of starch found in the sprayed samples was 19.06 per cent., and in the unsprayed samples 17.43 per cent.

Cider Vinegar: Its Solids and Ash. BY R. E. DOOLITTLE AND W. H. HESS. *J. Am. Chem. Soc.*, 22, 218-220.—The solids of pure cider vinegar consist of glycerol, albuminous substances, gums, malic and other organic acids, and mineral matter; they give no rotation with the polariscope and little or no reduction of Fehling solution after clarification with lead acetate. The ash, which should not be less than 0.75 per cent., consists mainly of potash with small amounts of sulphuric and phosphoric acids. A spurious vinegar was found to be composed of dilute acetic acid, glucose, and soda ash; another, of acetic acid, boiled cider, and lime.

The Oregon Prune. BY G. W. SHAW. *Ore. Agr. Expt. Sta. Bull.*, 61, 1-18.—This bulletin contains the results of analysis of fresh and cured prunes, showing their proximate composition, food value, and soil draught.

Commercial Fertilizers. *Me. Agr. Expt. Sta. Bull.*, 60, 24-29; *R. I. Agr. Expt. Sta. Bull.*, 60, 39-48; *La. Agr. Expt. Sta. Bull.*, 58, 190-264; *Ky. Agr. Expt. Sta. Bull.*, 85, 79-129; *Wis. Agr. Expt. Sta. Bull.*, 81, 1-8; *N. Y. Agr. Expt. Sta. Bull.*, 173, 531-552; *Vt. Agr. Expt. Sta. Bull.*, 77, 141-147.

ANALYTICAL CHEMISTRY.

PROXIMATE ANALYSIS.

A. G. WOODMAN, REVIEWER.

Foreign Coloring Matter in Milk. BY ALBERT E. LEACH. *J. Am. Chem. Soc.*, 22, 207-210.—The principal substances used at present to color milk are annatto, caramel, and yellow aniline dyes. To detect their presence about 150 cc. of milk are curdled by heat and acetic acid and the curd separated as much as possible from the whey. The curd is macerated for an hour or more with ether which extracts only the annatto. If the curd, after pouring off the ether, is not left perfectly white the presence of one of the other colors may be suspected. A portion of the fat-free curd is placed in a test-tube and shaken with con-

centrated hydrochloric acid. The gradual formation of a blue color indicates the presence of caramel, the immediate formation of a pink tinge the presence of the aniline color.

A Comparison of Some Formaldehyde Tests. BY B. M. PILHASHY. *Pharm. Rev.*, 18, 115-118.—From a study of several qualitative tests proposed for formaldehyde the author finds that in the method proposed by Trillat (*Compt. Rend.*, 116, 891), using dimethylaniline and sulphuric acid, the reaction is due to the excess of dimethylaniline and not to the formaldehyde. He considers the best reagent for formaldehyde to be phenylhydrazine hydrochloride, used either with sulphuric acid and sodium acetate or with sodium nitroprusside and strong caustic soda, the limit of delicacy being about 1 : 250,000 in the first case, and 1 : 1,000,000 in the second. The reviewer would point out, however, that the value of the test is limited by the fact that the reaction is given by furfural in the first instance, and that acetaldehyde gives a red color which tends to mask the reaction in the second case.

Methods for the Detection of "Process" or "Renovated" Butter. BY W. H. HESS AND R. E. DOOLITTLE. *J. Am. Chem. Soc.*, 22, 150-152.—The methods proposed are based mainly upon an examination of the curd. The curd of process butter consists mainly of coagulated casein in distinction from the curd of true butter which contains the proteids of the cream. The two kinds of curd may be distinguished readily by the greater amount of albumin found in the "process" butter curd.

The Technical Analysis of Licorice Pastes. BY M. TRUBEK. *J. Am. Chem. Soc.*, 22, 19-21.—The author describes the methods in ordinary use together with the method which he has devised for the determination of glycyrrhizin. The results of analysis are given for fresh and spent licorice root.

The Determination of Glycogen and Relative Quantities of Glycogen in Different Parts of the Flesh of a Horse. BY J. K. HAYWOOD. *J. Am. Chem. Soc.*, 22, 85-93.—After trying a number of methods proposed for the determination of glycogen with unsatisfactory results, the following method was settled upon. About 50 grams of the ground meat are digested on the water-bath for six hours with 300 cc. of a one per cent. potassium hydroxide solution. The solution is then made slightly acid, and the proteids completely precipitated by alternate additions of hydrochloric acid and double iodide of potassium and mercury. An aliquot part of the filtered extract is exactly neutralized with potassium hydroxide, three or four drops of strong hydrochloric acid are added, and the glycogen is precipitated by the addition

of 95 per cent. alcohol. This is filtered off, washed, dried at 80° – 100° C., then at 115° , and weighed. A number of analyses are given showing the amount of glycogen in different cuts of horse meat.

Chemical Methods for Ascertaining the Lime Requirement of Soils. BY H. J. WHEELER, B. L. HARTWELL, AND C. L. SARGENT. *J. Am. Chem. Soc.*, **22**, 153–177.—Among a number of methods tried, those which gave results most nearly comparable with the results of field tests on Rhode Island soils were: (1) Treatment of the soil with dilute ammonia and weighing the humus extracted. This method is applicable only when the acidity is due largely to organic matter. (2) A method of titration, based on measuring the number of milligrams of nitrogen, combined as ammonium salts, held by the soil when treated with very dilute ammonia. The results by this method agree quite closely with the results of crop tests. (3) Comparison of the color of a direct ammonia extract of the soil with the color of a similar extract of a soil of known character. This method is rapid and gives fairly good results.

A. H. GILL, REVIEWER.

On Hubl's Iodine Method for Oil Analysis. BY A. H. GILL AND W. O. ADAMS. *J. Am. Chem. Soc.*, **22**, 12–14.—The authors recommend the use of mercuric iodide instead of the chloride, whereby the formation of chloride of iodine is prevented. The results obtained show a decided decrease in the amount of substitution, nearly the theoretical value being obtained for oleic acid.

On the Determination of Volatile Combustible Matter in Coke and Anthracite Coal. BY R. K. MEADE AND J. C. ATTIX. *J. Am. Chem. Soc.*, **21**, 1137.—The authors find that by the usual method (of Blair) some carbon is burned. Their study of the matter has led to the following results: The larger the crucible and flame used, the greater the loss; the tighter the joint between cover and crucible, the less the loss; the larger the sample, the less the loss; the fineness and per cent. of ash also exercise some influence. It is suggested that the amount of carbon burned during the heating process can be very closely determined by a second ignition, the difference in weight being the amount burned. This gives results approximating closely to those obtained by ignition in nitrogen or hydrogen.

The Determination of the Bromine Absorption of Oils. BY P. C. McILHINEY. *J. Am. Chem. Soc.*, **21**, 1084–1090.—The process resembles that published some years ago by Snodgrass

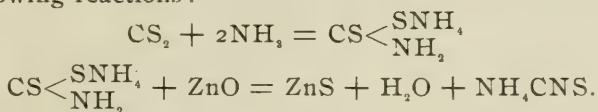
and Mills, except that it is more rapid, and the quantity of bromine both added and substituted is determined. For this purpose the oil is dissolved in carbon tetrachloride, and a measured quantity of one-third normal bromine in the same solvent added; after the reaction is completed, which requires two minutes, the excess of bromine is determined by potassium iodide and thio-sulphate. The hydrobromic acid formed by substitution is determined similarly by using potassium iodate. The process seems accurate, easily executed, rapid, and cheap, and should find wide acceptance.

On the Rancidity of Fats. BY ISKAR NAGEL. *Am. Chem. J.*, 23, 173-176.—The paper gives the results of some experiments upon rancid fats which were carried on under the late Prof. Benedikt. Free fatty acids and hydroxy acids are easily removed by an aqueous solution of water-glass, which completely prevents emulsions. Volatile lactones, alcohols, esters, some aldehydes, acetals and terpenes can usually be removed by distillation with steam. Either steam alone or steam mixed with hydrogen or carbon dioxide, or distillation at 100°-170° with a gas current or at diminished pressure may be employed for the purpose. The non-volatile lactones are boiled with alkali to change them to salts; the aldehydes are removed by the bisulphite method; and the acetals are changed to the alcohols and aldehydes by treatment with sulphuric acid, and these substances are then removed as already explained.

The Analysis of Essential Oils. BY CLEMENS KLEBER. *Am. J. Pharm.*, 71, 566-584.—The subject is one requiring a thorough knowledge, especially as the oils contain double-bonded compounds which change rapidly. An example of this change is shown in the case of the oil of cloves, which, when prepared by an improved process in half the usual time, gave an increased yield and finer fragrance. It is shown further that an oil prepared in the laboratory where only a seven per cent. yield was obtained, could not be considered as a criterion by which to judge of an oil obtained by a technical distillation in which 18 per cent. was obtained. With each sample of oil should be a statement giving: (1) genus and species of plant used; (2) portions of plant used; (3) time at which plant was collected; (4) method of distillation; (5) time since distillation was made; (6) specific gravity, rotation, refraction, and dispersion; (7) solubility in various strengths of alcohol; (8) saponification and esterification numbers. A specific gravity below 0.84 indicates aliphatic compounds, above 0.9, oxygenated substances, and above 1.0, aromatic substances. Insolubility in 70 or 80 per cent. alcohol indicates hydrocarbons, in larger quantities of 90 per cent. alcohol

paraffines, sesqui- and polyterpenes. After these preliminary tests the analysis proper is undertaken, using first a small portion of the oil and then if the method employed has proved successful, the bulk of the oil, never trusting the entire stock of the oil to an untried or doubtful method of procedure. As cold does not decompose the oils, they are subjected to a chilling process, often separating crystals of menthol, borneol, etc. This can be followed by treatment with sodium bisulphite, thus separating the aldehydic and ketonic bodies, which would be destroyed by the subsequent treatment. In this process it should be borne in mind that in some cases the bisulphite compounds form very slowly, requiring several days, as in the case of thujone. Another difficulty is due to the fact that some aldehydes, like citral, unite with a second molecule of sodium bisulphite yielding liquid compounds. The aldehydic substances being removed, the acids and phenols are separated by treatment with caustic potash or soda solution, too strong solutions not being used as these dissolve hydrocarbons. Fractional distillation of the residue now follows, preferably at a reduced pressure of 15 mm.; various distilling flasks and receivers employed for this purpose are shown. The article closes with a table giving the more frequently occurring constituents of the essential oils arranged in the order of their boiling-points.

The Estimation of Bisulphide of Carbon. BY A. GOLDBERG. *Am. Gas Light J.*, 72, 531.—The method depends upon the following reactions:



The substance under examination is heated on a water-bath in a strong, tightly-closed flask with 5 cc. ammonia (sp. gr. 0.91) and 25 cc. absolute alcohol, to a temperature of 60°, although 100° does no harm. When the reaction is finished, the solution which should be of a yellow color, is considerably diluted, a known volume of a standard ammoniacal solution of zinc is added, and the solution is heated to boiling with continuous stirring. The excess of zinc is determined by a standard solution of sodium sulphide using sodium nitroprusside as an indicator. The results of four analyses agreed well.

APPARATUS.

A. H. GILL, REVIEWER.

Description of a New Respiration Calorimeter. BY W. O. ATWATER AND E. B. ROSA. *U. S. Dept. Agr. Bull.*, 63; *Phys.*

Rev., 9, 129-163.—“The essential features of the apparatus are : 1. A chamber in which the subject of the experiment, a man, lives, eats, drinks, sleeps, and works during a period of several days and nights. 2. Arrangements for ventilation by a current of air which is drawn in from out of doors and passes through the chamber. The volume of this current is measured and the percentage of moisture in it and carbon dioxide contained in it determined before and after leaving the chamber ; the temperature of the air is the same when leaving as upon entering. 3. Arrangements for passing food and drink into the chamber and removing the solid and liquid excreta. 4. Arrangements for measuring the heat given off from the body of the man in the chamber and the heat equivalent of the external muscular work.” The inner chamber is provided with double walls ; the innermost wall is of polished copper and measures $7 \times 6\frac{1}{2} \times 4$ feet inside ; outside of this and separated from it by an air space of 3 inches is a zinc wall. This is surrounded with three concentric walls of wood 2 inches apart. In the spaces between these latter walls air is made to circulate by fans. To measure the temperature of the zinc and copper walls, 304 thermoelectric junctions of German silver-iron are employed. It being so arranged that no heat can escape or enter through the walls of the calorimeter, the heat generated is measured and carried away by a stream of water flowing through a copper “ absorber.”

A Simplified Reductor. BY P. W. SHIMER. *J. Am. Chem. Soc.*, 21, 723-4.—The differences from the usual form consist in the use of a small quantity of amalgamated zinc, 80 grams, supported upon a sand filter in a narrow tube. The hot lower part of the reductor is particularly effective in the reduction.

Apparatus for the Analysis of Illuminating and Fuel Gases. BY G. E. THOMAS. *J. Am. Chem. Soc.*, 21, 1108-1112.—The apparatus is essentially a modification of the well-known Orsat apparatus, and cannot be described without the figure. No results of work with the apparatus are given, although they are stated to be “ eminently satisfactory.” In view of the fact that the explosion is made over water and that the “ illuminants ” are absorbed with bromine, it is difficult to understand how this can be the case. Nor would this description seem to apply to the apparatus itself ; for since it contains eight glass stop-cocks, it must be expensive to make and maintain ; and from the shape of the absorption bottles it must be fragile and cumbersome.

Note on a Method of Standardizing Weights. BY T. W. RICHARDS. *J. Am. Chem. Soc.*, 22, 144-149.—The weights are compared by substitution, the comparison beginning with centi-

grams and proceeding upwards; the weights, being the objects to be weighed, are placed on the left hand pan. Every weight is compared with every other weight of the same size and with the sum of the smaller weights; the centigram weight is assumed to be correct and from it the values of all the other weights can be determined. The data and results of standardizing a set of weights are given as an illustration.

Laboratory Method for the Continuous and Uniform Generation of Acetylene for its Purification. BY J. A. MATHEWS. *J. Am. Chem. Soc.*, 22, 106-108.—The fragments of calcium carbide are suspended in a basket of coarse wire netting in a wide-mouthed bottle; the bottle is closed with a doubly perforated stopper carrying a dropping tube and gas delivery tube; and the carbide is covered with 95 per cent. alcohol. The water in the alcohol starts the generation of gas which is continued by the addition of more water, the temperature being kept low by the alcohol. When the carbide is used up, the alcohol may be distilled off giving nearly absolute alcohol, especially if the first few cubic centimeters coming over be rejected. The gas is purified by passing through acid copper sulphate solution and chromic acid.

A Simplification of Beckmann's Boiling-point Apparatus. BY S. L. BIGELOW. *Am. Chem. J.*, 22, 280-7.—The various asbestos stoves, mantels, lamps, etc., are replaced by a heating coil of platinum wire 20 cm. long, and 0.1 mm. in diameter. A current of two amperes gives ample heating effect for all ordinary solvents. The coil is connected up by sealing the ends through a tube afterwards filled with mercury, into which the lead wires dip. A felt mantle or preferably a Dewar's vacuum-jacketed vessel complete the apparatus. The results obtained with it by students were very satisfactory.

A Method for the Determination of the Melting-point. BY M. KUHARA AND M. CHIKASHIGÉ. *Am. Chem. J.*, 23, 230-233.—The modification consists in replacing the familiar capillary tube by a pair of halved microscope cover glasses held together by pieces of platinum foil and wire. This permits the heat of the bath to be conducted throughout the whole mass and enables a sharp melting-point to be taken, it being shown by the glass becoming transparent. The results obtained agree well with the usually accepted melting-points.

Absorption Apparatus for Elementary Organic Analysis. BY FRANCIS G. BENEDICT. *Am. Chem. J.*, 23, 323-334.—A U-tube containing a graduated vial for the condensation and collection of water, sealed in the bend with strong sulphuric acid,

and having one arm filled with glass wool saturated with acid, is used for the absorption of water. Carbon dioxide is absorbed in slightly moistened soda-lime, two U-tubes being used, the last one being partly filled with pumice stone saturated with sulphuric acid. The increase in the second tube is usually 7 milligrams; if it be more, the first tube should be renewed. For drying the air or oxygen a 12-inch chloride of calcium jar containing pumice drenched with sulphuric acid is used; this has a tubulus sufficiently removed from the base that the cavity may contain about 20 cc. of acid.

An Apparatus for Determining Molecular Weights by the Boiling-point Method. BY HERBERT N. MCCOY. *Am. Chem. J.*, 23, 353-360.—The apparatus used is a modification of Landsberger's, the change consisting in boiling a part of the solvent in a jacket outside the tube in which the substance, the molecular weight of which is to be determined, is contained. This vapor is conducted through the solution in the inner tube. By this method an equilibrium is easily maintained between vapor and solution, and condensation is avoided, so that six determinations of the boiling-point may be made with the same amount of substance where only two were formerly possible. The results agree well with those obtained by Beckmann.

A Distilling Column for Illustrating the Principle of Fractional Distillation and of Dephlegmators. BY OSWALD SCHREINERS. *Pharm. Rev.*, 18, 8.—The apparatus consists of a Coffey's distilling column of twelve sections arranged for drawing off the various fractions and determining their boiling-points. Results are given showing the concentration obtained.

A Method for Carrying out Chemical Reactions under High Pressures. BY B. H. HITE. *Am. Chem. J.*, 22, 80-86.—A platinum or collapsible lead or tin paint tube closed with a screw cap is placed in a lead tube 6 inches long and $1\frac{1}{4}$ inches in diameter, is filled with water, closed with a lid, and placed in a steel cylinder (6 x 7 inches) with a hole through it $1\frac{1}{4}$ inches in diameter. The lead tube rests upon a plug closing the lower end of the steel cylinder, while the upper end is closed by a piston; upon this the pressure is exerted by means of a hydraulic press, pressures up to 100 tons per square inch being employed. The effect of the arrangement is to enclose the liquids to be tested in one continuous piece of metal. Arrangements are made by means of a cylinder fitted with a screw, whereby this pressure can be maintained for a considerable length of time.

A Modified Soxhlet Apparatus for the Extraction of Fat from Liquids. BY A. E. TAYLOR. *Am. J. Physiol.*, 3, 183-5.—The

modifications consist in raising the junction of the siphon tube with the body of the extractor so as to leave about 110 cc. of liquid in the latter. The solvent passes to the bottom of the extractor through a tube ending in a rose connected with the condenser, and thence up through the liquid. No cork connections are used. The apparatus is easily made and cleaned.

H. M. GOODWIN, REVIEWER.

Three Additions to the Kohlrausch-Ostwald Conductivity Method. BY J. LIVINGSTON R. MORGAN. *J. Am. Chem. Soc.*, 22, 1-5.—The first addition consists of the substitution of a special magnetic vibrator operated at a distance for the usual vibrating spring contact in the primary circuit of the induction coil; the second, the familiar use of extension coils at the end of the slide wire bridge; and the third, the use of two contact points on the slide wire to assist in locating the position of points where the sound heard in the telephone is of equal intensity.

'A New Interrupter for the Kohlrausch-Ostwald Conductivity Method. BY J. LIVINGSTON R. MORGAN. *J. Am. Chem. Soc.*, 22, 26-28.—A slight modification of the interrupter referred to above. The wire carrying the primary current of the induction coil vibrates between the poles of an electromagnet, the contact being made and broken through a mercury cup.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. VI. No. 7.

ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

INORGANIC CHEMISTRY.

HENRY FAY, REVIEWER.

Note on the Preparation of Metallic Lithium. By LOUIS KAHLENBERG. *J. Phys. Chem.*, 3, 602-603.—Lithium may be obtained in white metallic form from solutions of lithium chloride in pyridine by electrolysis at room temperature. By electrolyzing a concentrated solution of the chloride, using a carbon plate for anode and an iron plate for cathode, a current of from 0.2 to 0.3 ampere per 100 sq. cm. of cathode area, and a difference of potential of but 14 volts between the electrodes, a dense, well-adhering, silver white coating of metallic lithium will soon be deposited.

The Supposed Isomeric Potassium Sodium Sulphites. By GEO. S. FRAPS. *Am. Chem. J.*, 23, 202-214.—According to Röhrig two isomeric sodium potassium sulphites may exist, the one being formed by neutralization of acid sodium sulphite with potassium carbonate, the other by neutralization of acid potassium sulphite with sodium carbonate. Schwicker claims to have obtained two double salts, $4\text{C}_2\text{H}_5\text{SO}_3\text{Na} + \text{KI}$, and $4\text{C}_2\text{H}_5\text{SO}_3\text{K} + \text{NaI}$, by heating the isomeric sulphites with ethyl iodide and recrystallizing from alcohol, the former by starting from acid sodium sulphite and potassium carbonate, and the latter by starting from acid potassium sulphite and sodium carbonate. This would indicate the existence of the isomeric salts $\text{K}-\text{SO}_2-\text{ONa}$ and $\text{Na}-\text{SO}_2-\text{OK}$. The work of Schwicker was repeated; the two salts which were supposed to be isomeric were heated with ethyl iodide, the time of heating and the strength of alcohol with which the product was extracted being varied. The product was analyzed for sodium and potassium. If the salts were isomeric there should be a difference in the ratio of sodium to potassium. The variation in the ratio $\text{Na}:\text{K}$ in the different experiments is

ascribed to the difference in the conditions. The author found that recrystallization from alcohol, and the use of absolute alcohol increased the ratio, but in seven sets of experiments no values were found which would indicate the isomerism of the two salts.

Preparation and Properties of the So-Called "Nitrogen Iodide." BY F. D. CHATTAWAY AND K. J. P. ORTON. *Am. Chem. J.*, 23, 363-368.—The most convenient method of preparing nitrogen iodide, $N_2H_3I_3$ is by bringing together ammonia solution and a cold solution of iodine monochloride, made by treating iodine with a mixture of hydrochloric and nitric acids to which ice has been added. The black precipitate of nitrogen iodide which at once separates may be filtered off with safety, and washed with dilute ammonia. The salt in crystalline form may be obtained by adding 15 cc. tenth-normal iodine monochloride to 100 cc. half-normal potassium hydroxide, and then adding, as rapidly as possible, 100 cc. of ammonia of sp. gr. 0.88. Glittering copper-colored crystals separate after a few moments; they are small, flattened, orthorhombic needles, dichroic, and have a specific gravity of 3.5. Pure nitrogen iodide is without action on litmus, does not give the reaction of iodine with chloroform; but in contact with water it is slowly decomposed. It may be dried in an atmosphere of ammonia over lime without decomposition, if light, to which it is extremely sensitive, be excluded. Nitrogen is slowly given off in diffused light from the compound suspended in water; in direct sunlight effervescence takes place. The partially decomposed substance is more explosive than the pure salt.

The Action of Reducing Agents upon Nitrogen Iodide. BY F. D. CHATTAWAY AND H. P. STEVENS. *Am. Chem. J.*, 23, 369-376.—All ordinary reducing agents when brought in contact with nitrogen iodide suspended in water rapidly decompose it, and the quantity of reducing agent oxidized is found in every case to be exactly double the amount equivalent to the hydriodic acid produced. The reducing agents investigated were sodium sulphite, stannous chloride, hydrogen sulphide, sulphurous, arsenious, and antimonious acids. Nitrogen iodide prepared by different methods was used, and in each case the ratio of the amount of reducing agent oxidized, to that of the hydriodic acid produced was 2 : 1. The influence of the action of light upon the ratio was very marked.

On the Cause of the Evolution of Oxygen when Oxidizable Gases are Absorbed by Permanganic Acid. BY H. N. MORSE AND H. G. BYERS. *Am. Chem. J.*, 23, 313-322.—It was suggested in a former paper (*this Rev.*, 5, 1) that the evolution of

oxygen which occurs when hydrogen or carbon monoxide is absorbed by acidified solutions of potassium permanganate is due to the action of the peroxide which is formed upon the excess of permanganic acid; and, further that the cause of this action of the oxide upon the acid may be a tendency on the part of the simpler peroxide molecules to polymerize to more complex ones at the expense of the acid. The experiments show, as regards carbon monoxide, that when this gas is absorbed by neutral solutions of potassium permanganate there is no evolution of oxygen; but when an acid is afterwards added, there is an evolution of oxygen similar in all respects to that which is observed when an equal volume of the gas is absorbed by an acidified solution of permanganate of the same concentration. If the reduction of the acid is due to the tendency to form complex molecules, then the evolution of oxygen should gradually diminish in rapidity as the polymerization increases. This has been shown to be the case, and further it has been shown that when the gas is absorbed in acid solution the period of rapid evolution does not terminate with the disappearance of the gas, as it should if the gas is the direct cause of the liberation of oxygen. Polymerization should also require, if the quantity of the gas absorbed remains constant, that the volume of oxygen liberated within a given time increases with increasing concentration of the permanganic acid. This has also been proved to be the case. The experiments were carried out in a tube holding 100 cc. which was agitated at a nearly constant temperature.

Permanganic Acid by Electrolysis. BY H. N. MORSE AND J. C. OLSEN. *Am. Chem. J.*, 23, 431-443.—In order to obtain manganese dioxide entirely free from potassium and other impurities the authors have devised an apparatus by which they can electrolyze potassium permanganate and obtain pure permanganic acid. The cell is composed of a beaker holding 1800 cc., placed in a galvanized iron tank through which water is kept passing. In the beaker is a porous cup of 250 cc. capacity in which is placed the negative electrode, made of a silver plate 50 mm. square, and a siphon through which the alkali may be drawn off. In the beaker the platinum positive electrode dips into a potassium permanganate solution containing about 40 grams of the salt in a liter. As a rule, the cells were found to have a low resistance in the beginning, amounting to from 5 to 10 ohms on the first day, rising to 25 or 30 ohms on the second day, and declining on the third and fourth days to 10 or 14 ohms. Different porous cells were tried, and it was found that the more porous, the smaller was the yield of acid. Using an ordinary battery cup the yield of acid has usually been from 87 to 92 per cent. of the theoretically possible amount. The concentration of

the acid was usually 9-10 per cent. Advantage was taken of the phenomenon of "electrical endosmose" for the concentration of the acid. With a current varying between 1 and 1.5 amperes, about 500 cc. of water passes out of the permanganate solution into the cup. By replacing the water thus drawn off by a 4 per cent. permanganate solution, 20 grams of the salt could be added each day. The electrical conductivity of an acid made from silver permanganate was measured and was found to agree more closely with the previous determinations of Lovén, than with those of Franke. Experiments were also made with other permanganates and with potassium dichromate which, it was found, can be electrolyzed in a similar manner.

A Contribution to the Knowledge of Tellurium. By F. D. CRANE. *Am. Chem. J.*, 23, 408.—The author has studied the different methods of precipitation, purification, and determination of tellurium. The crude material was obtained by extracting with hydrochloric acid the residue from the electrolytic refining of copper, and precipitating by means of acid sodium sulphite. It was found that the tellurium may be precipitated by means of metallic magnesium, the excess of this metal being converted to oxide by boiling, and subsequently dissolved by acetic acid. A convenient means of removing selenium from solution was found to be by the addition of freshly precipitated tellurium which throws out of solution all of the selenium; and it is stated that it will also throw out the more metallic elements which usually accompany tellurium, but no experiments are given to confirm this statement. It was shown that tellurium may be detected in very dilute solutions by acid sodium sulphite, and that ferrous sulphate is an equally sensitive reagent for selenium (see *this Rev.*, 6, 63) even in the presence of tellurium tetrachloride, but not in that of the dichloride. In order to avoid certain suspected sources of error, and to add nothing but hydrochloric acid as a reagent, a method of dissolving tellurium by electrolytic chlorine was devised. For the determination of tellurium a special form of apparatus was devised, whereby it might be filtered, washed, and dried in a current of hydrogen. Inasmuch as five of the six results given are high, and as tellurium has a remarkable tendency to absorb other substances when precipitated as metal—the precipitation having been made with acid sodium sulphite—the apparatus seems to the reviewer to be an unnecessary refinement. A yellow, crystalline form of tellurium dioxide was obtained by pouring a solution of tellurium tetrachloride in hydrochloric acid into boiling water.

On Chlorine Heptoxide. By ARTHUR MICHAEL AND WALLACE T. CONN. *Am. Chem. J.*, 23, 444-446.—Perchloric acid

was prepared by bringing together 25 grams of perchlorate and 100 grams of sulphuric acid (sp. gr. 1.839 at 15°) in a fractionating flask whose low lateral tube was connected with a second flask placed in a freezing-mixture. The mixture in the fractionating flask was heated under 10–20 mm. pressure in a paraffin bath. The reaction starts at 90°, and in an hour the temperature may be raised to 160°. The yield of slightly colored acid was 85–90 per cent. In contact with paper or wood it explodes, carbonizing the material; but it may be mixed with well-cooled alcohol without explosion. To prepare chlorine heptoxide, perchloric acid was brought slowly into contact with phosphorus pentoxide in a retort cooled below –10°. The retort is allowed to stand in the freezing-mixture for a day, then connected with a well-cooled receiver, and slowly warmed in a water-bath to 85°, when the oxide passes over. The freshly prepared substance may be redistilled under ordinary pressure. Chlorine heptoxide is a colorless, very volatile oil, which on standing turns yellowish green with liberation of a greenish gas. Brought into contact with a flame it explodes violently, but in contact with most substances it is remarkably stable. It may be poured on wood, paper, or similar organic substances with impunity. No reaction takes place with stick sulphur even after standing several days. It may likewise be poured on a cooled piece of phosphorus and remain several days without being attacked. A slow reaction takes place when it is brought into contact with benzene or iodine. With cold water it sinks to the bottom of the vessel, and slowly passes over into perchloric acid.

Some New Tellurium Compounds. BY VICTOR LENHER. *J. Am. Chem. Soc.*, 22, 136–141.—The chlortellurates and the bromtellurates of methyl, and ethylamine, aniline, pyridine, and quinoline, and the bromtellurate of trimethylamine were prepared by bringing together solutions of their salts in the corresponding halogen acids. The precipitate thus formed was purified by recrystallization from an acid solution. Since the author has not mentioned the preparations in which the salts were brought together, we are led to infer that only the 2 : 1 type of salt is capable of existence, but it seems more than probable that others of not so simple a type could have been isolated if the proportions of the two salts had been varied.

The Thermochemistry of Iron and Steel. BY E. D. CAMPBELL. *J. Am. Chem. Soc.*, 22, 205–206.—This paper is a withdrawal of a former article entitled “A Preliminary Thermochemical Study of Iron and Steel” (*this Rev.*, 3, 2). It is now shown that the solution of carbide of iron in double chloride of copper and ammonium is much accelerated when a small quantity of

free hydrochloric acid is present, but that the amount of free acid up to 4 per cent. does not appreciably influence the amount of heat evolved. The heat of solution of steel in slightly acid copper ammonium chloride is not changed more than 2 per cent. by variation in the heat or mechanical treatment of the sample.

Notes on Selenium and Tellurium. BY EDWARD KELLER. *J. Am. Chem. Soc.*, 22, 241-245.—In a previous paper (*this Rev.*, 4, 4) the author pointed out the difference of behavior of selenium and tellurium in the dioxide state, towards sulphur dioxide and ferrous sulphate in solutions of hydrochloric acid. These reactions have now been studied with the idea of using them for the quantitative separation of the two elements. It has been found that selenium is most readily precipitated by sulphur dioxide in strong hydrochloric acid solution while tellurium is not precipitated until the acidity of the solution is lowered to 80 per cent. Details are given for the application of this method to the quantitative determination of selenium and tellurium in copper. The author has found that in commercial work the criticism against determining tellurium in the metallic state on account of oxidation is unjustified.

Upon Bismuth Cobalticyanide. BY J. A. MATHEWS. *J. Am. Chem. Soc.*, 22, 274-277.—The quantitative precipitation of bismuth cobalticyanide was studied. The precipitate is crystalline, settles and filters well, and retains water below 165°. The author remarks that it has not been found useful in the analysis of pig-lead, as anticipated, "but it may still be found useful in the analysis of lead-bismuth alloys, 'fusible metals' such as Wood's alloy, etc." His results do not, however, in the least indicate its usefulness. Below a concentration of 0.0079 gram of bismuth per cubic centimeter the precipitation was under no conditions complete, and at ten times that dilution no precipitate was produced even on long standing.

METALLURGICAL CHEMISTRY.

H. O. HOFMAN, REVIEWER.

The Zellweger Roasting Kiln. BY J. ZELLWEGER. *Eng. Min. J.*, 69, 260-262.—This is a straight-line, single-hearth, mechanical reverberatory roasting furnace, 15 × 135 feet, with external fire places. The new feature is the rolling stirrer which turns over the ore and moves it slowly from feed to discharge. It consists of a heavy shaft carried by wheels, 6 feet in diameter, rolling on tracks in the depressed wheel-pits on either side of the hearth. The shaft carries a number of collars on which are mounted projecting V-shaped blades. While travelling from feed to dis-

charge, the collars are locked to the shaft, and the blades scoop up the ore during one-half of a revolution and discharge it during the other half, thus stirring, mixing, and moving it. During the return trip, the collars are unlocked, and revolving around the shaft cause the blades to displace the ore only about in the same way that a plow or rake would. The furnace is in use at the works of the Cherokee Lanyon Spelter Co., Gas City (Iola), Kans., and treats in twenty-four hours 15 tons of blende reducing the sulphur to 1 per cent., $12\frac{1}{2}$ tons if the sulphur is reduced to $\frac{1}{2}$ and $16\frac{1}{2}$ tons if $1\frac{1}{2}$ per cent. sulphur are allowed to remain in the roasted ore.

Utilizing the Heat of Molten Slag. BY H. LANG. *Eng. Min. J.*, 69, 493-494. BY BRETHERTON, *Eng. Min. J.*, 69, 614.—The author criticizes the claims made by Bretherton (*this Rev.*, 6, 45) that by means of his apparatus he is able to raise the temperature of the blast to 500° - 600° F. The second reference is to Bretherton's reply.

Notes on Lead Smelting and Gold and Silver Refining ; V, Cost of Smelting Silver-Lead Ores. BY M. W. ILES. *Eng. Min. J.*, 69, 258-259.—After a few general remarks on the relations that should exist among the officers in charge of a smelting plant, the author shows that between 1887 and 1898 the cost of smelting at the works of the Globe Smelting and Refining Co., Denver, Colo., was reduced from \$4.644 to \$2.260 per net ton of ore. In 1886, the blast-furnaces were 36×100 in. at the tuyeres, 11 ft. from tuyeres to throat, the blast pressure was 1 lb. per sq. in., the matte settlers had a capacity of 6 cu. ft. and slag was collected in pots holding 250 lbs. which were pulled by men. In 1899, the blast-furnaces were 42×120 in. at tuyeres, 16 ft. from tuyeres to throat, the blast pressure was 3-4 lbs. per sq. in., the matte boxes (at the Globe works) had a capacity of 128 cu. ft., and small switch-engines handled per trip 3000-6000 lbs. slag. The results were obtained with slags containing 31-34 per cent. SiO_2 . When a slag ran high in lead, this could be reduced by adding lime to the charge or in some cases by increasing the percentage of fuel. While iron flux was more expensive than limestone, it was often advantageous to make slags running high in iron on account of the larger amount of charge that could be put through with them. The author is confident that the cost of \$2.26 for smelting a net ton of ore can be further reduced by using coke made from washed coal (the present Colorado coke containing $16\frac{1}{2}$ -22 per cent. ash), and by improving the system of handling.

Notes on Lead Smelting and Gold and Silver Refining,—Apparatus for Collecting Solids from Smoke. BY M. W. ILES. *Eng. Min. J.*, 69, 647.—The paper is an illustrated description of a No. 2 Pelton wheel driving a Monogram Sturtevant blower which aspirates the smoke and delivers it into a tin box, 3 ft. square and 5 ft. high, with a discharging door at the side and thimble, 18 in. in diameter and 12 in. long, at the top. Over the thimble is placed a sack, 60 in. in circumference and 20 ft. long, made of plain woven cotton cloth having, per square inch of surface, 44–50 threads in the warp and in the woof. By running the apparatus for 10–14 days and gathering the filtered solids, a correct idea of the metal lost is easily obtained.

A Portable Stamp-Mill. BY TAYLOR. *Eng. Min. J.*, 69, 263.—The apparatus which serves to make working tests on small batches of gold ore, consists of two parts. The lower one is a cast-iron mortar (8 in. in diameter) with a square discharge (6 × 6 in.); the upper one, fastened to the mortar with a hinge-pin and hinge-bolt, is a cast-iron conical cover carrying two columns for the cam-shaft. The single stamp, weighing 45 lbs., is operated by hand and drops $6\frac{1}{2}$ –7 in. with a force of 750 lbs.; the ore is fed through an opening in the cover.

Water and Fuel Economy in Stamp Milling. BY A. W. WARWICK. *Eng. Min. J.*, 69, 529–530.—Engineers frequently assume that a ten-stamp gold mill requires about 800 gals. water per hour when the water is allowed to run off with the tailings. As to fuel and water consumption, using a locomotive boiler and an engine with a throttle governor, a fair figure is $8\frac{1}{3}$ lbs. coal and $7\frac{1}{2}$ gals. water per horse-power hour. The following data obtained by the author at the mill of the Matterhorn mine, in the southeast corner of the Mojave desert, show that an effective system of water saving will reduce the 800 gals., usually required per hour by a ten stamp mill, to 200 gals., or 75 per cent.

| Week. | Water supplied in gals. | Hours run. | Water per stamp per hour. Using ounce. | Actually used. | Per cent. recovered. |
|---------|----------------------------|---------------|--|-------------------|-------------------------|
| 1 | 13154 | 82 | 80 | 16.0 | 80.0 |
| 2 | 16760 | 80 | 95 | 22.2 | 76.8 |
| 3 | 15487 | 81 | 93 | 19.1 | 79.4 |
| 4 | 14850 | 80 | 92 | 18.5 | 79.8 |

On account of the large amount of water required for making steam, the author advocates the use of an oil-engine. At the Matterhorn mill a Fairbanks-Morse engine of 34 brake horse-power, with cooling water used continuously, required in twelve hours only 55 gals. water to make up the loss by evaporation.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. VI. No. 8.

ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

METALLURGICAL CHEMISTRY.

H. O. HOFMAN, REVIEWER.

The Montana and Denver Reduction Company's Mill at Bearmouth, Mont. BY F. D. SMITH. *Eng. Min. J.*, 69, 348-350.—The paper is an illustrated description of the mill which aims to do custom work on gold ores. It contains 5 ore-receiving bins of 20 tons' capacity, a Blake crusher 9×15 in., an elevator, a pair of rolls, a Vezin mechanical sampler, 4 storage bins with a capacity of 25 tons sowing 4 five-stamp batteries, a hydraulic seizer, 4 double-deck Wilfley tables, 4 cyanide tanks of 100 tons' capacity with the necessary zinc boxes, storage tanks, etc. The mill has a capacity of 60 tons in 24 hours, and is driven by an 80 horse-power engine, steam being furnished by two 50 horse-power boilers.

Hydraulic Amalgam Squeezer. BY FRAZER AND CHALMERS. *Eng. Min. J.*, 69, 499.—This apparatus, in use at the Treadwell mill, Douglas Island, Alaska, serves to free the gold amalgam collected from the mortar, plate, etc., more effectively from the surplus quicksilver than is possible when done by hand.

A Clean-up Trolley for Gold Mills. BY FRAZER AND CHALMERS. *Eng. Min. J.*, 69, 436.—This device consists of a trolley with cages and bucket. It is used for handling amalgam, shoes, dies, etc., during a clean-up, and thus facilitates the work and permits the collecting and cleaning of the amalgam to be done in one room under proper supervision.

Oxygen in the Cyanide Process. BY W. JONES. *Eng. Min. J.*, 69, 404.—The author emphasizes the necessity of supplying cyanide solutions with air, if they are to extract gold from slimes that have been stored for some time and thus have become contaminated with organic matter.

GENERAL AND PHYSICAL CHEMISTRY.

A. A. NOYES, REVIEWER.

Physical Reactions and the Mass Law. BY AZARIAH T. LINCOLN. *J. Phys. Chem.*, 4, 161-187.—A large part of the article is devoted to a summary of the previously published considerations of Bancroft (*Phys. Rev.*, 3, 21), who assumed that certain cases of heterogeneous physical equilibrium can be expressed by exponential formulas somewhat analogous to those which the Mass Action Law requires in the case of homogeneous chemical equilibrium. Thus, the quantities x and y of two non-miscible liquids which are present in a homogeneous mixture of them with a definite constant quantity of a third liquid miscible with both, at the point when separation into two layers just begins to take place, are assumed to be related to each other, in the way expressed by the equation $x^n y = C$, where n and C are arbitrary constants which may have any positive value whatever. In order to confirm the idea that this formula is not merely an empirical one, but is the expression of a "newly discovered Law of Nature," the author shows by experiments more accurate than those previously published that the formula does express, in most cases with a difference of less than one-third of a per cent. between the found and calculated values of one of the components, the condition of equilibrium between benzene, water, and ethyl alcohol at the point of saturation. The reviewer must, therefore, again call attention to the fact (see *Tech. Quart.*, 8, 306) that any two-phase heterogeneous equilibrium is determined by the composition of *both* phases, and that if the composition of both of them is variable, as is the case in the example above cited, a formula like that proposed which takes into account the composition of only one of them *can* have only an empirical significance.

On the System Water, Phenol, and Hydrochloric Acid. BY W. H. KRUG AND FRANK K. CAMERON. *J. Phys. Chem.*, 4, 188-192. The authors have determined the temperature at which solid phenol separates from the liquefied phenol layer formed when solid phenol is placed in contact with water and aqueous solutions of hydrochloric acid of various concentration. The freezing-point of the phenol was 1.365° with the pure water, and 17.195° with the most concentrated hydrochloric acid used, which contained 131.3 grams per liter. The results have no quantitative significance from a theoretical standpoint, for the authors have chosen for their investigation a phenomenon which is the resultant of two independent effects—first the reduction of solubility of the water in the phenol by the hydrochloric acid dissolved in the water,

and second, the lowering in melting-point of the phenol by the water dissolved in it.

On Two Theorems of Gibbs. BY PAUL SAUREL. *J. Phys. Chem.*, 4, 193-199.—The author shows that Gibbs' equation expressing the relation between changes of pressure and temperature in a univariant system is equivalent to the Clapeyron-Clausius formula, whatever may be the number of components; and that Gibbs' equation for bivariant systems can, when certain conditions are satisfied, likewise be brought into the same form.

The Relation of the Taste of Acids to Their Degree of Dissociation. II. BY THEODORE WILLIAM RICHARDS. *J. Phys. Chem.*, 4, 207-211.—The author shows that the facts previously noted by several investigators that weak acids and acid salts have, in comparison with hydrochloric acid, a much sourer taste than is consistent with the assumption of proportionality between sourness and concentration of the hydrogen ions, is readily explained in accordance with the dissociation theory, contrary to the belief of Kahlenberg (*this Rev.*, 6, 73), if it be assumed that the act of tasting removes hydrogen ions and that these are replaced by the production of new ones, at the expense of the undissociated acid or acid salt. This same explanation has been independently suggested by the reviewer (*this Rev.*, 6, 73).

Isohydric Solutions. BY WILDER D. BANCROFT. *J. Phys. Chem.*, 4, 274-289.—It is shown that the Mass Action Law requires that there be a displacement of the equilibrium of any reaction: $aA + bB + \dots + mM = a_1A_1 + b_1B_1 + \dots + m_1M_1$ by the addition to the mixture of any volume of one of the substances, such as A_1 , even if the concentration of the latter in the volume added is equal to that of it in the original mixture, *except* in the case where $a + b + \dots + m = b_1 + \dots + m_1$. If the right-hand member of this expression is *greater* than the left-hand member, the right-hand system will increase in concentration; if *less*, it will decrease. The author applies the principle theoretically to a number of special cases of gaseous and electrolytic dissociation. Gaseous ammonium carbamate may be here cited as an example: in this case $a + b + \dots + m = 1$ and $b_1 + \dots + m_1 = 1$ if ammonia is added to the equilibrium mixture, and $b_1 + \dots + m_1 = 2$ if carbon dioxide is added; consequently there will be no change in the equilibrium in the former case, and an increase in the dissociation (or amount of carbamate volatilized) in the latter. This principle is especially applied to the dissociation of diionic salts, which, as previously pointed out by Storch, are not subject to the simple laws of isohydric solutions by reason of the fact that the exponents occurring in the expression of the empirical dilution law are appar-

ently, at least, not identical with those required by the Mass-Action Law. The author calculates from the empirically determined exponents that on mixing hundredth-normal solutions of potassium and sodium chlorides the dissociation, and therefore the conductivity, of each salt should be reduced over one per cent. An experiment made by A. T. Lincoln showed that, instead of the theoretical decrease, an increase of 0.8 per cent. occurs.

ANALYTICAL CHEMISTRY.

ULTIMATE ANALYSIS.

H. P. TALBOT, REVIEWER.

The Technical Estimation of Zinc. BY ALBERT H. LOW. *J. Am. Chem. Soc.*, 22, 198-202.—The ore is treated with nitric acid, first with the addition of potassium nitrate, later with that of a cold saturated solution of potassium chlorate in nitric acid, and the whole is evaporated to dryness. The residue is treated with an ammoniacal solution of ammonium chloride, the filtered solution made acid with hydrochloric acid, and, after the removal of the copper and cadmium by sulphuretted hydrogen, the zinc is titrated for by means of potassium ferrocyanide solutions, using uranium nitrate as an indicator. When cadmium is absent, the copper may be thrown out by means of test lead.

The Repeated Use of the Double Chloride of Copper and Potassium for the Solution of Steel or Iron in Estimating Carbon. BY GEO. WM. SARGENT. *J. Am. Chem. Soc.*, 22, 210-213.—The author finds that if chlorine is passed into the double chloride solution after it has been used to dissolve iron, it regains its color and is more energetic in its solvent action than when freshly prepared. As many as eleven portions of drillings have been treated successfully with the same solution, by regenerating it each time after use. Oxidation by means of an air current, or by electrolytic methods, was less successful than that brought about by passing chlorine gas into the solution.

Notes on Selenium and Tellurium. BY EDWARD KELLER. *J. Am. Chem. Soc.*, 22, 241-245.—A method for the quantitative separation of selenium and tellurium is based on the fact that sulphur dioxide will throw down selenium alone from cold solutions of the two elements containing about 80 per cent. by volume of concentrated hydrochloric acid, or one hundred times as much acid as tellurium.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. VI. No. 9.

ARTHUR A. NOYES, Editor.

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INDUSTRIAL CHEMISTRY.

F. H. THORP, REVIEWER.

The Fertilizer Resources and the Fertilizer Industry of Alabama. BY B. B. ROSS. *Proc. Ala. Industrial and Sci. Soc.*, 9, 51-58.—The article is mainly a historical sketch of the development of the fertilizer industry in the southern states, the present status of the manufacture in Alabama being well set forth. It appears that the raw materials, excepting cotton-seed meal, are mainly imported from the neighboring states, although phosphate rock of some value has been found in Limestone Co. The author's analyses of this rock are quoted as showing from 9 to 25.1 per cent. phosphoric acid. An acid phosphate made from this rock showed 14.90 per cent. total phosphoric acid, of which 13.15 per cent. was water-soluble. Valuable deposits of green sand marl are found in the state, the analyses given showing them to contain 2.24-2.74 per cent. phosphoric acid and 3.78-3.86 per cent. potash. Other materials found in the state are mucks, which are highly recommended for building up the soil. An analysis of bat manure from the Tennessee Valley demonstrated its fertilizer value to be above \$30 per ton, based on the scale of fertilizer values in the state. The paper closes with a discussion of the abstraction of nitrogen from the air by certain leguminous plants, such as the cow-pea, clover, and vetch, when grown upon land containing certain bacteria, which thus become valuable fertilizers when plowed under; and with a discussion of the advantages gained by inoculations of the soil with these bacteria from cultures.

Commercial Fertilizers. *Vt. Agr. Expt. Sta., Bull.* 79, 189-198; 80, 201-244.

The Effect of Salt Water on Cement. BY A. S. COOPER. *J. Franklin Inst.*, 148, 291-302.—Mortars containing various proportions of cement and sand were prepared with fresh water and with salt water. Briquettes made from each mixture were allowed to set for 24 hours in moist air, and then some from each mixture were put into salt water and fresh water to harden. Compression and tension tests were made on these after seven days and twenty-eight days, and at the end of six months and one year. The salt water briquettes showed better results in the earlier tests, but after longer periods the fresh water briquettes showed greater strength. It was also indicated that salt water tends to weaken concrete, but no definite opinion could be stated. It also appeared that rough, sharp sand, made by crushing hard rock, produced briquettes of greater strength, though much depends on the thoroughness of the ramming. It is also shown that mortar made with Portland cement suffers very little injury, even after several hours' standing, if it is kept thoroughly wet.

Manufacture of Alcohol from Acetylene. *U. S. Consular Rep.*, 62, 287-293.—The article consists of four reports by the Consuls at Paris, Berne, Berlin, and Frankfort, setting forth the present status of the industry. Letters from the leading authorities, Berthelot, Maercker, Rossel, and Liebetang, regarding the future prospects of the industry, are included. Descriptions of the manufacture are also given. The consensus of opinion appears to be that the fermentation-alcohol industry need not anticipate any competition from this direction. The cost of calcium carbide and the small yield of alcohol make the acetylene product about ten times as expensive as ordinary alcohol.

A New Electrolytic Process of Manufacturing Chemicals. BY JAMES BOYLE. *U. S. Consular Rep.*, 62, 189-191.—A short, popular review of the Hargreaves-Bird process, stating its economies and advantages, forms the substance of the report.

What is Parianite? BY S. F. PECKHAM. *J. Franklin Inst.*, 149, 161-193.—The author's conclusion is that at present we know very little concerning the composition of parianite; but he contends that the course of investigation already entered upon "will ultimately lead to conclusions that will be final." A description of the specimens is first abstracted from a previous paper (*Am. J. Sci.*, 1896); then the method of analysis is discussed. Considering parianite as an emulsion of gas, mineral water, bitumen, organic matter not bitumen, and mineral matter such as silica and clay; or as an emulsion of gas, water holding mineral salts, bitumen, and organic salts of iron, alumina, lime, and magnesia with ulmic and other peat acids, with ferrous sul-

phide and silica, the author holds that it cannot be determined of what the mixture consists by "any process that separates a hypothetical substance called petrolene and a second called asphaltene, a third called organic-matter-not-bitumen, and a fourth called mineral matter." There is also considerable discussion of the work of C. Richardson (see *J. Soc. Chem. Ind.*, 1897 and 1898) and numerous analyses by Miss L. Linton are given. An extended discussion of the paper follows in which Messrs. Endemann, Sadtler, Day, Keller, and Allen (Sheffield, England), and Prof. Peckham take part. Dr. Endemann concludes from his investigations that some asphalt contains a hydrocarbon, $C_{26}H_{38}$; and that hard asphalts contain an oxygen compound to which he assigns the formula $C_{26}H_{36}O_2$, or with new asphalts, $C_{20}H_{24}O_2$. He thinks the ulmic acid of Peckham comes from the turpentine used in the extraction rather than from the asphalt. He considers asphalt as an oxidation-product of petroleum; and he found, by heating a petroleum oil with potassium bichromate, sulphuric acid, and water, for two to four months on a water-bath, that the oil thickens and takes on the odor of asphalt.

Recent Progress in the Aluminium Industry. By Jos. W. RICHARDS. *J. Franklin Inst.*, 149, 451-459.—Reduction processes are still the same in principle as the Hall process of ten years ago. The cost of materials and working has been materially reduced. The cost of aluminum is now about two-thirds that of brass. Aluminum is now worked into light and strong alloys; five per cent. of copper, nickel, or manganese, or thirty per cent. of zinc make strong metals with aluminum. The use of the metal for culinary utensils, for novelty goods and bric-a-brac, for lithographic plates, and electric conductors has reached large proportions; over 500 tons were used last year for transmission lines and feed wires, replacing copper. Powdered aluminum is used for silvery printing and paint, as on the U. S. mail boxes; also for the reduction of refractory metallic oxides, such as those of manganese, chromium, tungsten, molybdenum, vanadium, uranium, and boron. Many of these, alloyed with iron, are used in making steel at Krupp's works.

Railway Bearings: An Investigation of Causes of Hot Boxes in Railway Service, and Methods for Their Prevention. By ROBERT JOB. *J. Franklin Inst.*, 149, 439-450.—Bearings which had run hot on cars from different railroads while passing over the Philadelphia and Reading R. R., were examined metallographically and chemically. Test sections were cut, and the tensile strength and elongation determined. Along with these tests a number of alloys were made, to check the accuracy of the

deductions and to determine the best conditions of foundry practice. In composition wide variations were found. Some consisted of copper-tin in the ratio of 7 : 11. Others were of copper-zinc, with as high as 35 per cent. of zinc; these seldom caused heating, but were subject to rapid wear. Phosphor bronzes were found in moderate numbers; but the copper-tin-lead alloys, averaging 10-15 per cent. of tin with from 15-5 per cent. of lead, were most common. In most cases it appeared that the composition caused but little of the difficulty, the chief causes of the heating effects being: segregation of the metals; coarse crystalline structure; dross or oxidation-products; and excessive amount of gas enclosed in the metal. Deficient lubrication appeared to have caused but little of the trouble. Segregation, caused by attempts to alloy the metals in improper proportions, especially in the copper-tin-lead compositions, where the liquation of the excess of lead or the separation of copper resulted, caused surfaces of high heating capacity. Photomicrographs are shown of a number of compositions. The composition of one which had heated in service was: copper, 74.67; tin, 15.27; lead, 10.27 per cent. Segregation is best prevented by slow pouring and rapid cooling in the mold. Crystalline structure was found to be due to antimony in some cases, but often was caused by rapid pouring at too high temperature, or by the use of an excess of deoxidizing agents. It increased local friction, decreased the tensile strength, and caused excessive wear. Particles of dross held mechanically caused friction and heating. Occluded gas tended to reduce the bearing surface of the metal, thus increasing the pressure and causing rapid wear. Deoxidizing agents, especially phosphorus, remove the occluded gases. Zinc in proportion of 1 or 2 per cent. has been shown by Dr. Dudley to act as a deoxidizer, but more than this weakens the metal. Sodium acts similarly. The author approves of the addition of silicon in small proportion with the zinc, to obtain a fine-grained ductile metal. Arsenic has been used as deoxidizer, but it has no advantage. Tensile strength and elongation limits in bearing metals are essential, as experiments demonstrated that increase of strength and ductility means increased life to the bearings in service. The etchings for microscopic examination were made on the polished metal, commonly by the use of decinormal solution of iodine in potassium iodide; but in a few cases, dilute chromic or nitric acid was used.

New Method of Bleaching in Germany. *U. S. Consular Rep.*, 63, 253.—A short account of Koechlin's process of bleaching vegetable fibers by the use of bisulphite of sodium, or lime, or the "hydrosulphite" of calcium. The goods are then steamed under one to two atmospheres' pressure. In another pro-

cess the goods are exposed for six hours to the action of alkali, soap, calcined magnesia, and hydrogen peroxide. These bleaches are claimed to do no injury to the fibers.

Sod Oil, Wool Grease, and Degras. BY ERASTUS HOPKINS. *J. Am. Chem. Soc.*, 22, 351-353.—By a confusion of names in paragraph No. 279 of the tariff act of 1897, a question as to the identity of wool grease and sod oil arose, and an investigation of the nature of these substances was undertaken. It was shown that sod oil and wool grease have different constitutions and characteristics. Wool grease is extracted from sheep's wool; sod oil is an oxidized oil expressed from leather which has been curried with fish oils. Sod oil contains a substance designated as "degras former," which is stated to be characteristic of this oil; it is not present in wool grease, nor in other oils. Degras is a trade name including both substances.

A. H. GILL, REVIEWER.

Texas Petroleum. BY F. C. THIELE. *Am. Chem. J.*, 22, 489-493.—The Corsicana oil resembles the Lima oil, but does not have the disagreeable odor of the latter; it has a specific gravity of 0.829, and seems to be closely related to the Pennsylvania oil of the Washington district; it contains a certain proportion of substances closely resembling asphaltum, as is shown by its giving a precipitate with SnCl_4 . The oil from the Nacogdoches district is black and very heavy, and strongly impregnated with sulphuretted hydrogen, resembling a maltha. Its specific gravity is 0.915. Saratoga oil has a gravity of 0.955, and that of Sour Lake a gravity of 0.963, the heaviest oil in this hemisphere. It leaves a residue of 71 per cent. above 641°F. , and contains no paraffin, but 20 per cent. asphaltum. It is composed of hydrocarbons excellently well adapted for lubricating purposes. A pitchy mass was obtained from the oil, which resembled that obtained from the distillation of stearin, a fact which may substantiate the theory of Höfer and Engler regarding the origin of petroleum.

BIOLOGICAL CHEMISTRY.

A. G. WOODMAN, REVIEWER.

On the Elimination of Nitrogen, Sulphates, and Phosphates after the Ingestion of Proteid Food. BY H. C. SHERMAN AND P. B. HAWK. *Am. J. Physiol.*, 4, 25-49.—Experiments conducted upon healthy human subjects under normal conditions of nutrition show that the rates of excretion of nitrogen and sulphates are quite similar, the minimum being reached during the

night; the rate of excretion of phosphates, however, is essentially different from either and reaches a minimum after breakfast. When lean beef, sufficient to furnish about 63.7 grams of extra protein, was taken, the nitrogen excretion began to rise in the first three hours and reached a maximum between the sixth and ninth hours, again reaching the normal after about thirty-six to thirty-nine hours. The increased excretion of sulphates followed the same general course. The increased rate of excretion of the phosphates reached a maximum at the same time as that of the nitrogen, but regained the normal after about twelve to fifteen hours. The increased heat of combustion of the urine was but little greater than would correspond to an amount of urea equivalent to the extra nitrogen eliminated.

The Gluten Constituents of Wheat and Flour and Their Relation to Bread-making Qualities. BY H. A. GUESS. *J. Am. Chem. Soc.*, 22, 263-268.—The author has tabulated the results of analysis of a number of samples of Canadian wheat, giving the locality, the buyer's grading mark, the percentages of gliadin and glutenin, the ratio of the two, and a "composite factor" representing the product of this ratio by the total percentage of gluten. This composite factor is considered to be more truly a measure of gluten value, since it represents the total number of units of gluten present multiplied by the value per unit.

The Digestibility of American Feeding-stuffs. BY WHITMAN H. JORDAN AND FRANK H. HALL. *U. S. Dept. Agr., Expt. Sta. Bull.*, 77, 1-100.—This bulletin contains a compilation of the experiments made at experiment stations in the United States on the digestibility of feeding-stuffs by farm animals. A résumé of the data practically complete to 1899 is given, coefficients of digestibility for all important American feeding-stuffs being thus available.

Analyses of Strawberries. BY G. W. SHAW. *Ore. Agr. Expt. Sta. Bull.*, 62, 6-9.

A Normal Chlorine Map of Long Island. BY GEORGE C. WHIPPLE AND DANIEL D. JACKSON. *Tech. Quart.*, 13, 145-148.—The map constructed from the results of analyses of eighty samples of water, apparently normal, shows that, except at the eastern end of the island, the normal chlorine is below six parts per million. At the eastern end the chlorine is very high and varies greatly in different localities, resembling the chlorine of Cap Cod, in Massachusetts, in this respect.

ANALYTICAL CHEMISTRY.

PROXIMATE ANALYSIS.

A. G. WOODMAN, REVIEWER.

Soil Humus : Some Sources of Error in Analytical Methods.

BY A. L. EMERY. *J. Am. Chem. Soc.*, 22, 285-291.—The author points out three sources of error in ordinary methods of soil analysis: (1) In washing samples free from calcium salts with dilute hydrochloric acid, some of the organic matter is liable to be dissolved. (2) When the soil is leached with caustic potash, part of the nitrogen is expelled as ammonia, the amount depending upon the nature of the soil and the time of leaching. (3) When the soil is leached with ammonia water, ammonia is taken from the solution and held in combination with the organic matter. Since nitrogen in the humus is determined by dividing the nitrogen in the potash extract, which is too low, by the humus, which is too high, the error is multiplied, and the result is almost invariably too low.

An Examination of Brown and Taylor's Official Method of Identifying Butter.

BY JOHN A. HUMMEL. *J. Am. Chem. Soc.*, 22, 327-329.—The increasing production of "renovated" butter makes it important to have some ready method for its identification. In chemical properties and composition the differences between renovated and normal butter are too slight to be of use, but the difference in behavior towards polarized light is sufficient in many cases to indicate the character of the sample. This difference is shown by photomicrographs of representative preparations.

On the Relation of the Reducing Power of Normal Urine to the Amount of Certain Nitrogen Compounds Present.

BY J. H. LONG. *J. Am. Chem. Soc.*, 22, 309-327.—The author has determined directly the reducing power of uric acid and creatinin in terms of cupric oxide, using a modified form of Pavy's solution. The total reducing power of the urine and also the amounts of nitrogenous substances present was likewise determined. It was found that on the average 46.6 per cent. of the total reducing power was due to sugar, corresponding to 1.514 grams per liter, or about 0.15 per cent.

On Acetic Acid as a Substitute for Ethyl Alcohol in Extracting the Active Principles of Some Official Drugs.

BY EDWARD R. SQUIBB. *Am. J. Pharm.*, 72, 311-319.—In this paper, the author on the subject, the author gives the results obtained on buckthorn and cascara sagrada.

ULTIMATE ANALYSIS.

H. P. TALBOT, REVIEWER.

On the Determination of Carbon and Hydrogen by Combustion in Oxygen, Using Copper Oxide. BY CHARLES F. MABERY AND WILLIAM R. CLYMER. *J. Am. Chem. Soc.*, 22, 213-218.—To purify the oxygen and air used during combustions, two pieces of combustion tubing 1.75 meters long and bent at the ends are filled with broken glass moistened with concentrated sulphuric acid in one case and 40 per cent caustic potash solution in the other. These may be fastened to the wall. Sulphuric acid is found to be the best absorbent for water, and if not more than 2-3 cc. are used to collect the water, no carbon dioxide is retained under the conditions of an ordinary combustion. The gas flow may reach 1000 cc. per hour without loss. A rate of 500 cc. per minute through the potash bulbs does not cause loss of moisture, when the calcium chloride is freshly fused and finely granular. In the combustion of hydrocarbons the tube should be first filled with oxygen before volatilization commences. As high a heat as can be used without danger to the life of the combustion tube, is desirable.

Note: Test for Tin. BY ALLEN ROGERS. *J. Am. Chem. Soc.*, 22, 220.—The addition of a stannous chloride solution to one of ammonium molybdate, as usually prepared, gives a blue tint to the mixture, even in the presence of only 0.0000042 gram of stannous chloride per cubic centimeter.

The Estimation of Alumina and Ferric Oxide in Natural Phosphates. BY F. P. VEITCH. *J. Am. Chem. Soc.*, 22, 246-258.—Ammonium phosphate is added to the solution of the aluminum, then ammonia to alkaline reaction, the resulting precipitate is redissolved in hydrochloric acid, and the number of cc. required to accomplish this, after the solution has become acid, is noted. The solution is diluted to 250 cc., and for each cc. of acid added 5 cc. of a 50 per cent. ammonium thiosulphate solution is now dropped in slowly. On boiling for half an hour the aluminum is precipitated, and the precipitate is washed, dried, ignited, and weighed as AlPO_4 . Two precipitations are necessary in the presence of large quantities of iron or lime. Magnesium, sodium, and potassium salts are without effect; silica and fluorine must be previously removed; the sulphates present must not exceed the equivalent of 1.25 grams of sulphuric acid.

The Distillation of Ammonia in the Determination of Nitrogen. BY FRANCIS GANO BENEDICT. *J. Am. Chem. Soc.*, 22, 259-263.—To hasten the complete transference of the liberated

ammonia to the receiving flask, a device is used by which the condenser water is run off after a definite time, allowing the whole delivery-pipe to be heated for a few moments by the steam. In this way the time of distillation is shortened, without danger of loss of acid from the solution in the receiving flask.

Lime and Sulphuric Acid by the Photometric Method. BY J. I. D. HINDS. *J. Am. Chem. Soc.*, 2, 2 269-274.—This paper is supplementary to an earlier one on the same subject (*J. Am. Chem. Soc.*, 18, 661). A table is appended to facilitate the calculation of percentages.

A Rapid Method for the Determination of Carbon in Iron or Steel by Combustion. BY GEO. WM. SARGENT. *J. Am. Chem. Soc.*, 22, 277-285.—An apparatus is described in detail with which a combustion may be completed in twenty minutes. The author points out that a stream of electric sparks may replace the copper oxide, although, on account of the wear upon the terminals of the induction coil as a result of constant use, the employment of the oxide is still advised.

On the Preparation of Potassium Xanthate for Nickel Determinations. BY E. D. CAMPBELL. *J. Am. Chem. Soc.*, 22, 307-308.—Commercial xanthate does not give satisfactory results when used in the author's method for the determination of nickel (*J. Am. Chem. Soc.*, 17, 125). A procedure is described for the preparation of a pure, stable salt from absolute alcohol, carbon disulphide, and potassium hydroxide.

Remarks on some Methods of Determining Carbon in Steel. BY GEORGE AUCHY. *J. Am. Chem. Soc.*, 22, 334-343.—The methods commented upon are: The loss on ignition of carbon sponge; the combustion methods, wet and dry; and the color method. Suggestions are made as to possible sources of error in each procedure.

A Method for the Determination of Zinc by the Use of Standard Thiosulphate Solution. BY RICHARD K. MEADE. *J. Am. Chem. Soc.*, 22, 353-356.—The procedure is analogous to that proposed by the author for the determination of magnesium (see *this Rev.*, 5, 100). The zinc is precipitated as zinc ammonium arsenate in a slightly acid solution, and the precipitate is dissolved in hydrochloric acid. Potassium iodide is added to the solution and the liberated iodine measured by means of a thiosulphate solution. Calcium and magnesium are first removed by precipitation with arsenate in an alkaline solution. Manganese must be removed as dioxide by potassium chlorate.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. VI. NO. 10.

ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and W. H. Walker; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

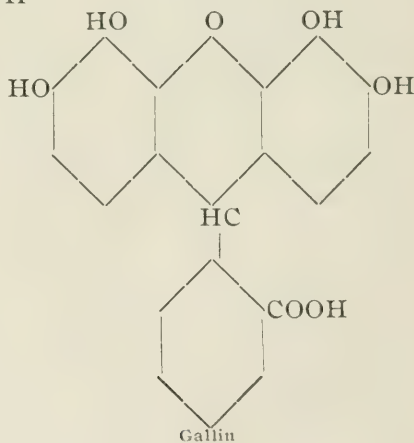
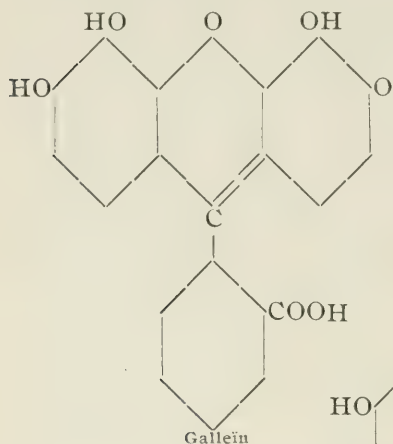
ORGANIC CHEMISTRY.

J. F. NORRIS, REVIEWER.

On Certain Colored Substances Derived from Nitro Compounds. BY C. LORING JACKSON AND F. H. GAZZOLO. *Am. Chem. J.*, 23, 376-396; *Proc. Am. Acad.*, 35, 263-281.—In continuing the study of the colored substances formed by the action of sodium alcoholates on certain nitro compounds, the authors have succeeded in obtaining colored products by treating trinitroanisole or trinitrobenzene with the sodium compounds of malonic ester, acetoacetic ester, phenol, and benzyl cyanide. The compounds containing malonic ester and acetoacetic ester are stable and were found on analysis to consist of three molecules of the sodium salt of the ester combined with one of the trinitro compound. Similar experiments with sodium methylate, ethylate, or amylate and trinitrobenzene led to analogous results. The formation of compounds of this composition is noteworthy, since all the substances prepared heretofore have contained the constituents in equal molecular proportions. The compounds were obtained as highly colored precipitates by treating a solution of the nitro compound in benzene with the sodium salt of the ester made by the action of sodium on the ester in the absence of alcohol. The compounds are decomposed by dilute acids, giving the aromatic constituent unaltered, and by alcohols. When the methyl compound is allowed to stand with benzyl alcohol, the methyl groups are replaced by benzyl. The compound so formed is converted into the corresponding methyl derivative when it is boiled with methyl alcohol. Experiments with picramide, dinitroxylol, and trinitroxylol showed that an increase in the negative nature of the aromatic constituent, increases the tendency to form colored compounds. The presence of methyl groups, however, diminishes the tendency to form these com-

pounds. There was no color reaction with trinitromesitylene and sodium methylate. No colored compounds were obtained by the action of sodium alcoholates on aromatic bodies rich in negative groups, but containing no nitro groups. The authors conclude that the compounds are without doubt addition-products and not substitution-products, as suggested by Victor Meyer, and that the addition probably takes place at both the carbon and nitrogen atoms in the aromatic constituent.

The Constitution of Gallein and Coerulein. BY W. R. ORNDORFF AND C. E. BREWER. *Am. Chem. J.*, **23**, 425-431.—A revision of the work on the reduction-products of gallein leads to the conclusion that hydrogallein and gallol are identical with gallin. Gallein is the phthalein of pyrogallol, and gallin is the corresponding phthalin. The following formulae are assigned to the compounds from a study of their esters :



A methyl and an ethyl ester were made by boiling gallein with the corresponding alcohol and a little sulphuric acid. Gallein triphenylcarbonate was prepared by heating gallein with phenyl isocyanate. Colored tetramethyl and tetraethyl ethers were also prepared. Gallein reacts as if it had the tautomeric, lactoid formula also, for it gives a colorless tetracetate, tetrabenzoate, and tetraphenylsulphonate. It also gives colorless tetramethyl and tetraethyl ethers. Its trimethyl ether resembles closely phenolphthalein in its properties. The constitution of gallin was shown by the fact that it gives a colorless tetracetate and pentamethyl ether. The tetracetate was proved to be an acid by the preparation of a silver salt. The pentamethyl ether has no acid properties and is easily saponified. Formulae for coerulein and coerulein are proposed, which bring out the relation of these compounds to anthragallol. A description of the above-mentioned compounds will be furnished later by the authors.

Researches on the Sodium Salts of the Amides. BY HENRY L. WHEELER. *Am. Chem. J.*, 23, 453-471.—A comparative study of the rate of formation of the sodium salts of the acid amides was made, in order to obtain additional evidence for the structure of these compounds, and to determine whether stereochemical interference was noticeable in the reaction. In working out the experimental details it was found necessary to devise a new method for the preparation of the sodium salts. When a boiling solution of the amide in benzene was treated with sodium amalgam, the reaction took place readily, and a number of compounds yielded sodium derivatives, which could not be obtained by the previously existing methods. To determine whether the velocity of salt formation is dependent on the relative acidity of the molecule, the anilides of formic, acetic, oxalic, and benzoic acids were studied. The results showed that there was no relation between the two quantities; the rate of the formation of the salt of oxanilide was, for example, only a little more than half that of formanilide. That basicity does not exert the most important influence, the acyl group being the same, was shown by experiments with benzamide, benzanilide, and benzoylbenzylamine. Ammonia and benzylamine have practically the same affinity constants, yet the velocity of salt formation with benzamide was nearly 100 times as great as that with benzoylbenzylamine. Experiments with a number of compounds to determine which of the two general forms, $RNHCOH$ or $HNHCOR$, is more favorable for salt formation showed "that a disubstituted formamide gives a salt less readily than one that is monosubstituted, which would be expected from the theory of stereochem-

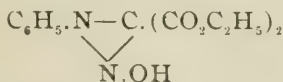
ical interference; and that when the larger or interfering radical is attached to nitrogen it has less effect in retarding the formation of sodium salts than when attached to the keto group. They, therefore, indicate that the sodium is attached to oxygen." The above statement does not always hold true, for it was found that the isomeric cycloamides, oxindol, and phthalimidine, were completely changed into their sodium salts, while, under the same conditions, benzoylbenzylamine was practically unchanged. Since stereochemical interference was found to have an influence on the reaction investigated, the amide of 2-4-6-trimethylbenzoic acid was studied. A sodium salt was readily prepared. As this acid is inactive in reactions which are supposed to involve an addition to the keto group, but does enter into reactions involving direct substitution, the fact that a sodium salt was formed from the amide points to the conclusion that, in the salt, the metal is joined to nitrogen. If this view is incorrect, then 2-4-6-trimethylbenzamide must, contrary to the theory of stereochemical interference, form an addition-product of the amide and sodium hydroxide, in the preparation of the sodium salt, in which the elements of the alkali are joined to the keto group. The elimination of water from such a compound would yield a sodium salt of the amide in which the metal is joined to oxygen. An experiment showed this to be the case. 2-4-6-Trimethyl- and 2-4-6-tribrombenzamide formed compounds with sodium hydroxide containing equal molecular quantities of the constituents. The addition-product containing bromine was prepared by pouring an excess of a solution of the amide in benzene on powdered sodium hydroxide. The fact that these addition-products have the elements of the alkali joined to the keto group and are not so-called molecular compounds, was shown by the action of benzoyl chloride on the sodium hydroxide addition-product of thioacetanilide, whereby acetanilide and thiobenzoic acid was formed.

Note on the Constitution of Diparabrombenzylcyanamide.

By C. LORING JACKSON AND R. W. FULLER. *Am. Chem. J.*, 23, 494-500; *Proc. Am. Acad.*, 35, 231-236.—In order to obtain evidence of the structure of dialkylcyanamides, di-*p*-brombenzylcyanamide was prepared and studied, as this substance crystallizes well (m. p. 133°) and yields, on decomposition, a compound which can be obtained in a pure condition. When the cyanamide was treated with dilute sulphuric acid, dibrombenzylamine, ammonia, and carbon dioxide were formed. This reaction proves that the compound has the structure represented by the formula $R_2 : N.CN$ and not the possible imide structure, $R.N : C : N.R$.

On the Action of Nitrous Acid on Ethyl Anilinomalonate.

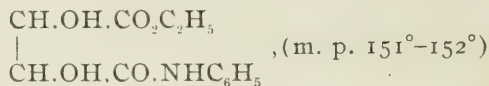
By RICHARD SYDNEY CURTISS. *Am. Chem. J.*, **23**, 509-511.—When ethyl anilinomalonate was suspended in water and treated with sodium nitrite and sulphuric acid, a thick amber-colored oil was obtained, which was extremely unstable. This oil did not give Liebermann's nitroso reaction, but showed marked acid properties. It yielded well crystallized, but unstable salts when treated with sodium or potassium hydroxide. By the action of acetic anhydride two crystalline substances were obtained. From the properties of the oil the author concludes that the compound has the following structure :



On Nitromalonic Aldehyde. By HENRY B. HILL, CHARLES A. SOCH, AND GEORGE OENSLAGER. *Am. Chem. J.*, **24**, 1-15.—In a former paper (*Am. Chem. J.*, **22**, 89) it was shown that nitromalonic aldehyde readily reacts with acetone, and that the product formed is *p*-nitrophenol. This condensation of nitromalonic aldehyde with a number of ketones has been studied, and the conclusion is drawn that the reaction is a general one. Condensation took place most readily in dilute aqueous solution in the presence of a small amount of alkali. The reaction-mixture was allowed to stand twenty-four to forty-eight hours at ordinary temperatures, when the yield was almost quantitative. Methyl-ethyl ketone gave on condensation nitrocresol ($\text{CH}_3\text{I}, \text{OH}_2, \text{NO}_{2.5}$). From dibenzyl ketone, 2,6-diphenyl-4-nitrophenol (m. p. 135° - 136°) was prepared. This compound formed a potassium salt from which the corresponding anisol (m. p. 152° - 153°) was prepared. The nitrophenol was reduced to an amido compound (m. p. 149° - 150°), which was readily oxidized to diphenylbenzoquinone (m. p. 135° - 136°) which in turn was reduced to a hydroquinone (m. p. 179° - 180°). Nitromalonic aldehyde and acetoacetic ester gave nitrosalicylic acid ($\text{OH}_1, \text{COOH}_2, \text{NO}_{1.4}$). With levulinic acid, 5-nitro-2-oxyphenylacetic acid, which melts at 160° - 162° when rapidly heated, was obtained. If the acid is melted by prolonged heating at 148° - 149° it is converted into its lactone (m. p. 187° - 188°). The ethyl ester of the acid melts at 154° - 155° . 2,6-Di-carboxy-4-nitrophenol, formed from nitromalonic aldehyde crystallizes with one molecule of water of crystallization, melts when anhydrous at 213° - 214° , and is converted by fuming nitric acid into picric acid.

The Preparation of Zinc Ethyl. BY ARTHUR LACHMAN. *Am. Chem. J.*, 24, 31-39.—Detailed directions for the preparation of zinc ethyl in quantity are given. The zinc-copper couple used is made by reducing a mixture of 100 parts of zinc dust and 12 parts of copper oxide powder in a stream of hydrogen. The results of a number of experiments show that the method is rapid and gives an excellent yield. The author gives some valuable information in regard to the manipulation of zinc ethyl.

The Reactions of Aniline and Hydroxylamine with Hydroxy- and Unsaturated Compounds. BY ALFRED TINGLE. *Am. Chem. J.*, 24, 45-60.—The author has undertaken an investigation of the characteristic reactions of the group $-\text{CH} : \text{C.OH}$. As the group under investigation contains two reactive elements, a double bond and a hydroxyl group, it seemed best to study in the beginning, first a compound containing no double bond but a hydroxyl group which is rendered more active by the presence of a highly negative radical, and, second, a compound containing a double bond and a negative group. As examples of these two classes of bodies, ethyl tartrate and ethyl cinnamate were used. The action of aniline and of hydroxylamine on the substances was studied, but the results do not yet warrant any definite conclusions. When ethyl tartrate was boiled with aniline, tartranilide and a body which appeared to be ethyl phenyltartrate,



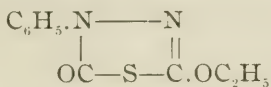
were formed. This reaction shows that the hydroxyl group, under these conditions, is inactive toward an amine. The ester did not react with hydroxylamine in a number of experiments. Aniline was found to react with neither ethyl nor sodium cinnamate. With hydroxylamine, however, there was a complicated reaction which led to the formation in aqueous solution, of an oil, which is at present under investigation, and phenylisoxazolone. When aniline was boiled with methyl salicylate the products were phenol and methylaniline. As the yield is very good the author proposes to extend the reaction to the preparation of other alkylanilines.

On the Molecular Rearrangement of the Thioncarbamic, Thioncarbanilic, and Thioncarbazinic Esters: β -Alkyl- α - μ -diketotetrahydrothiazoles. BY HENRY L. WHEELER AND BAYARD BARNES. *Am. Chem. J.*, 24, 60-83.—It has already been shown by the authors that thioncarbamic esters, $\text{H}_2\text{N.CS.OR}$

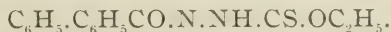
are readily converted into the isomeric thiol compounds, $H_2N.CO.SR$, by the action of alkyl halides. In the present paper are given the results of an examination of certain thion esters, $XHN.CS.OR$, under the same conditions. The experiments led to the preparation of some homologues of α - μ -diketo-tetrahydrothiazole and of sulphocyanacetic acid. When X in the above formula is C_6H_5 , the compounds, thioncarbanilic esters, react less readily with alkyl halides than the thioncarbamic esters. When X is the group C_6H_5NH , however, the compounds, thioncarbazine esters, react with great ease with both alkyl and acyl halides. To prepare phenyl thioncarbazine ester, ethyl dithiocarbonate was treated with phenylhydrazine. In addition to the compound sought, the hydrazone $C_6H_5NH.N:C.SC_2H_5.OC_2H_5$ was obtained. When this hydrazone is treated with thio-benzoic acid, the compounds unite at the double bond and subsequently break down with the formation of phenylthiolcarbazine ester and ethyl thiolbenzoate. The hydrazone can be converted into thioncarbazine ester by the action of hydrogen sulphide or hydrogen chloride. The reaction involves the formation of addition-products and the subsequent elimination of ethyl mercaptan and ethyl chloride respectively. The addition-product containing hydrogen chloride was isolated. The hydrazone reacts energetically with acetyl and benzoyl chlorides. With the latter compound an addition-product is formed, which breaks down into ethyl chloride and the compound



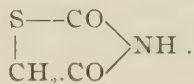
Phenylthioncarbazine ester is converted at ordinary temperatures into the corresponding thiol compound by alkyl halides. It reacts with phosgene giving ethoxyphenylthiobiazolone,



and gives a benzoyl derivative of the following structure :

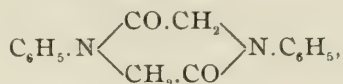


The action of chloracetic acid on ethyl thioncarbamate is analogous to that of the alkyl halides: an addition-product is first formed, which loses ethyl chloride and is thus converted into carbaminthiolglycollic acid, $H_2N.CO.SCH_2.CO_2H$. This derivative of glycollic acid loses water and passes into α - μ -diketo-tetrahydrothiazole,



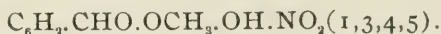
Derivatives of the above compound were prepared by replacing chloracetic acid by other halogen-substituted acids in the fatty series, and by the action of hydrochloric acid on the α -sulphocyan derivatives of the fatty acid esters. Reference must be made to the original paper for a more detailed account of the compounds mentioned and a description of a large number of esters of α -sulphocyanacetic acid and its homologues.

Formation of Indigo from Diphenyldiketopiperazine. BY M. KUHARA AND M. CHIKASHIGÉ. *Am. Chem. J.*, **24**, 167-171.—When diphenyldiketopiperazine,



prepared from chloracetanilide and potassium hydroxide, was cautiously fused with potassium hydroxide, it was converted into a brown substance, which, on solution in water, was rapidly changed into indigo. It is probable that in the reaction phenylglycocoll was first formed and that this, by the action of the alkali, went over to pseudoindoxyl which in turn was converted by the oxygen of the air into indigo. This synthesis explains the formation of indigo from bromacetanilide.

The Action of Nitric Acid on Vanillin. BY WILLIAM B. BENTLEY. *Am. Chem. J.*, **24**, 171-181.—Nitric acid even in a 5 per cent. solution, does not oxidize vanillin, but converts it into a mixture of nitrovanillin, dihydrodivanillin, and dinitroguaiacol. Under the proper conditions a good yield of nitrovanillin is obtained. The compound melts at 176°, and forms insoluble chromium, copper, and lead salts, and a potassium salt which crystallizes with one molecule of water of crystallization. Nitrovanillin is converted by nitric acid into dinitroguaiacol; its structure is, therefore,



By cautious treatment with potassium permanganate, nitrovanillin was oxidized to nitrovanillic acid, which was found to melt, after careful purification, at 216° and not at 202°, the melting-point assigned to it by previous investigators. The acid crystallizes with $1\frac{1}{2}$ molecules of acetic acid.

GENERAL AND PHYSICAL CHEMISTRY.

A. A. NOYES, REVIEWER.

Lecture Experiments. Reversible Chemical Reactions. BY W. LASH MILLER AND F. B. KENRICK. *J. Am. Chem. Soc.*, **22**, 291-300.—The mass-action law is qualitatively illustrated by six groups of experiments on the equilibrium of reactions familiar to students of elementary inorganic chemistry. The manipulation is described in detail; but in several instances it is not clear what the experiment is intended to illustrate; thus it is not apparent that the mass-action law requires that dilution with water should cause precipitation of silver bromide or of cupric hydroxide from their ammoniacal solutions, nor that the former salt should be precipitated by silver nitrate and potassium bromide, except through a consideration of the electrolytic dissociation theory, to which no reference is made by the authors.

Notes on Lecture Experiments to Illustrate Equilibrium and Dissociation. BY JULIUS STIEGLITZ. *Am. Chem. J.*, **23**, 404-408.—The first experiment described consists in sealing 0.029 gram bromine, in glass tubes of 40 cc. capacity, in one case with an equal molecular quantity of phosphorus tribromide (or trichloride), and in another case with nine (or six) times as much of these substances, and heating the tubes side by side in a beaker of water to 80°-90° (or 40°-55°). The brown color of the bromine vapor is much deeper in the tubes containing no excess of the phosphorus compound. The other experiments relate to electrolytic dissociation, and consist in showing that the color produced by adding a little ammonia to phenolphthalein or litmus solution is greatly weakened by the addition of concentrated ammonium chloride solution, owing to the reduction of the dissociation of the ammonium hydroxide.

On a Minimum in the Molecular Lowering of the Freezing-Point of Water, Produced by Certain Acids and Salts. BY VICTOR J. CHAMBERS AND JOSEPH C. W. FRAZER. *Am. Chem. J.*, **23**, 512-520.—The investigation is a continuation of that of Jones and Chambers (*this Rev.*, **6**, 72), and the results obtained are entirely similar. The substances investigated cryoscopically were copper sulphate, phosphoric acid, hydrochloric acid, sodium acetate, cadmium iodide, strontium iodide, and zinc chloride. All of them except the first show a marked minimum in the molecular lowering at concentrations between 0.05 and 0.5 mol per liter. The authors consider that the results further confirm the explanation, previously offered, that the quantity of solvent is reduced by the combination of it with the dissolved substance to form a hydrate.

On the Freezing-Points of Aqueous Solutions of Non-Electrolytes. BY E. H. LOOMIS. *Phys. Rev.*, 9, 257-287.—The method is essentially the same as that used by the author in his previous work (*this Rev.*, 3, 23), but an error due to a variation in the temperature of the stem of the thermometer is now eliminated. It is shown that no appreciable error is involved in the author's method by reason of a difference between the convergence temperature (Nernst and Abegg, *Ztschr. phys. Chem.*, 15, 681), and the true freezing-point, inasmuch as this difference was found by direct experiment to amount to only 0.004° . The molecular lowerings (calculated for 1 mol in a liter of solution) found by the author are given in the following table.

| Solute. | Concentration in mols per liter. | | | | | | |
|------------------------------|----------------------------------|------|------|-------|------|------|------|
| | 0.01 | 0.02 | 0.05 | 0.10 | 0.20 | 0.50 | 1.00 |
| Methyl alcohol..... | 1.83 | 1.81 | 1.82 | 1.82 | 1.83 | ... | ... |
| Ethyl alcohol..... | 1.81 | 1.84 | 1.84 | 1.85 | 1.85 | ... | ... |
| <i>n</i> -Propyl alcohol.... | 1.89 | 1.86 | 1.87 | 1.86 | 1.86 | ... | ... |
| <i>n</i> -Butyl alcohol..... | 1.89 | 1.84 | 1.85 | 1.86 | 1.86 | ... | ... |
| Amyl alcohol..... | 1.85 | 1.86 | 1.85 | 1.845 | ... | ... | ... |
| Glycerine..... | 1.86 | 1.86 | 1.86 | 1.87 | 1.88 | ... | ... |
| Dextrose..... | 1.88 | 1.84 | 1.86 | 1.88 | 1.90 | ... | ... |
| Cane-sugar..... | 1.87 | 1.89 | 1.89 | 1.92 | 1.98 | .. | ... |
| Mannite..... | 1.85 | 1.86 | 1.86 | 1.87 | 1.90 | 1.97 | ... |
| Acetone..... | 1.85 | 1.86 | 1.86 | 1.85 | 1.85 | ... | 1.91 |
| Chloral hydrate..... | 1.86 | 1.87 | 1.85 | 1.87 | 1.88 | ... | 2.05 |
| Aniline..... | 1.85 | 1.86 | 1.83 | 1.81 | 1.77 | ... | ... |
| Ether..... | 1.62 | 1.68 | 1.71 | 1.73 | 1.73 | ... | ... |

From plotting the results the author concludes that all the investigated substances exhibit at extreme dilution a constant molecular lowering of the value 1.86° , with the exception of the three substances methyl alcohol, ethyl alcohol, and ether, for which the extrapolated values are 1.82° , 1.84° , and 1.50° respectively. The author suggests that these apparent exceptions may arise from an error consisting in the evaporation of these volatile solutes out of their aqueous solutions during the experiment, but he has not adequately tested this explanation, which seems an entirely reasonable one, especially in the case of ether, which exhibits the most serious anomaly. Nevertheless, the investigation as a whole furnishes a comprehensive and most exact verification of the Raoult-van't Hoff principle and of van't Hoff's thermodynamical formula, by which the molecular freezing-point lowering for water is calculated to be 1.87° . Finally it is worthy of note that the deviations from this value rarely exceed 1 per cent. even in solutions containing as much as 0.1 mol per liter.

A Revision of the Atomic Weight of Iron. BY THEODORE WILLIAM RICHARDS AND GREGORY PAUL BAXTER. *Proc. Am. Acad.*, **35**, 253-260.—Ferric oxide made in two different ways, was ignited at 900° in a current of air, weighed, and then reduced in a current of electrolytic hydrogen at 900° . Two determinations with oxide prepared from precipitated ferric hydroxide gave 55.900 as the mean value of the atomic weight, and five determinations with oxide made from ferric nitrate gave on the average 55.883, the last value being considered nearest the truth. Experiments are described which prove that the ferric oxide occludes no appreciable amount of gas, and the same had been previously shown to be true of iron ignited in hydrogen. Previous determinations are criticized at the close of the article; and the errors which led to the higher value (56.0) commonly adopted are suggested.

On the Determination of Sulphuric Acid in the Presence of Iron: A Note on Solid Solutions. BY THEODORE WILLIAM RICHARDS. *Proc. Am. Acad.*, **35**, 377-383.—The author maintains, on the basis of the previously published experiments, that the precipitation of iron with barium sulphate is due to the occlusion, at the moment of the separation of the precipitate, of a complex basic compound of iron and sulphuric acid analogous to the well-known compound of chromium, and that the amount occluded will be dependent upon the amount of the complex salt present in the solution, in accordance with the distribution law.

The Driving Tendency of Physico-Chemical Reaction and Its Temperature Coefficient. BY THEODORE WILLIAM RICHARDS. *J. Phys. Chem.*, **4**, 383-393; *Proc. Am. Acad.*, **35**, 471-480.—The author first discusses the relations between the two familiar van't Hoff equations:

$$\frac{d}{dt} \ln \frac{c_1^{n_1} c_1'^{n_1'} \dots}{c_2^{n_2} c_2'^{n_2'} \dots} = \frac{U}{RT^2} \text{ and } \frac{d}{dt} \ln \frac{p_1^{n_1} p_1'^{n_1'} \dots}{p_2^{n_2} p_2'^{n_2'} \dots} = \frac{-\lambda}{RT^2}.$$

He emphasizes the advantages of the latter, designating it the reaction isobar, since λ represents the absorption of heat when the reaction takes place under constant external pressure. A further equation, designated the reaction metatherm, is derived, which includes both the case of a reaction at constant pressure and that of one at constant volume. In the latter part of the article it is suggested that there may be theoretical advantages in considering the equilibrium ratio, or constant (k) resolved into separate constant factors ($z_1, z_1' \dots$) characteristic of each of the reacting substances, of whose reciprocals the constant shall be the same function as it is of the partial pressures; that is

$$k = \ln \frac{p_1^{n_1} p_1'^{n_1'} \dots}{p_2^{n_2} p_2'^{n_2'} \dots} = \ln \frac{z_1^{n_1} z_1'^{n_1'} \dots}{z_2^{n_2} z_2'^{n_2'} \dots}.$$

The factors z_1, z_1', \dots are designated "single physico-chemical potentials," and the constant k is called "the driving tendency of the reaction," since it is regarded "as an opposing pressure tendency just equal to the ratio of the pressures actually observed."

A Table of Atomic Weights of Seventy-four Elements. By THEODORE WILLIAM RICHARDS. *Proc. Am. Acad.*, 35, 621.—The only changes, aside from the number of figures retained, from the table published by the same author two years ago (*this Rev.*, 4, 119), and the only important differences from the values recently adopted by Clarke (*this Rev.*, 6, 72), are shown below :

| | 1898. | 1900. | | Richards. | Clarke. |
|--------------|-------|-------|---------------|-----------|---------|
| Boron | 10.95 | 11.0 | Antimony.... | 120.0 | 120.4 |
| Calcium | 40.0 | 40.1 | Cerium | 140. | 139.0 |
| Iron | 56.0 | 55.9 | Iron | 55.9 | 56.0 |
| Selenium ... | 79.0 | 79.2 | Magnesium.. | 24.36 | 24.3 |
| Tungsten... | 184.4 | 184. | Palladium... | 106.5 | 107.0 |
| | | | Strontium ... | 87.68 | 87.60 |

A Preliminary Investigation of the Conditions which Determine the Stability of Irreversible Hydrosols. By W. B. HARDY. *J. Phys. Chem.*, 4, 235-253.—The author has shown that the particles of heat-modified proteid or egg-white in the form of a hydrosol (that is, in the form of an aqueous colloidal solution) are electropositively or electronegatively charged and move towards the one electrode or the other when subjected to the influence of a high difference of potential, according as the solution is acid or alkaline ; and that in neutral solution the electric field has no influence, in which case the particles and the fluids are said to be isoelectric. The isoelectric point is of great importance since it is also the point of minimum stability or of most ready coagulation of the hydrosol, this principle being generally applicable to hydrosols, in spite of the great differences in stability towards chemical agents which different ones exhibit. The article is, however, mainly devoted to the effect of various salts, acids, and alkalies in coagulating hydrosols. The author derives from his experiments the new principle that the coagulation is determined by that one of the two ions which has an electric charge opposite in sign to that of the colloidal particle ; and confirms the conclusion previously drawn by others that bivalent ions are enormously more active in causing coagulation than univalent ones, and that trivalent ions again are far more active than bivalent ions. In proof of this principle it is

shown that dialyzed silica, proteid in presence of a trace of alkali, dialyzed mastic, and colloidal gold, whose particles are all electronegative, are coagulated at once or in a relatively short time by aluminum sulphate, copper sulphate, or chloride, cadmium nitrate, barium chloride, and magnesium sulphate, but are not coagulated by equivalent solutions of potassium or sodium sulphate or of sodium chloride; while proteid in the presence of a trace of acid and dialyzed ferric hydrate, whose particles are electropositive, are coagulated at once by all the sulphates investigated, namely those of aluminum, copper, magnesium, potassium and sodium, but not by the chlorides of copper, barium, or sodium, nor by the nitrate of cadmium. The salt concentration necessary to coagulate ferric hydrate was found to be $1/4000$ mol per liter in the cases of potassium and magnesium sulphate, but $1/10$ to $1/50$ mol in the cases of the chlorides of sodium and barium and the nitrate of cadmium; similar concentration results are given also in the case of gum mastic and of colloidal gold. In accordance with the author's principle is also the behavior of acids and alkalies, for the concentration necessary for the coagulation of negative colloid particles by acids or of positive particles by bases is shown to be that at which the various acids or bases have the same specific conductivities and, therefore, approximately the same concentration of hydrogen or hydroxyl ions. On the other hand, the effect of acids on positive particles or of bases on negative particles, though somewhat irregular, is clearly dependent on the valence of the negative and positive ions respectively. A series of experiments is also given on the concentration of potassium sulphate necessary to produce coagulation of colloidal gold in solutions containing acetic acid or ammonia in various amounts. The article closes with a summarized statement of results, interspersed with hypothetical considerations.

On the Mechanism of Gelation in Reversible Colloidal Systems. BY W. B. HARDY. *J. Phys. Chem.*, 4, 254-273.—From a study of gelatine-water-alcohol and agar-water mixtures it is concluded that, in accordance with the view of van Bemmelen (*Ztschr. anorg. Chem.*, 18, 20), the jellies or gels produced by cooling consist of a framework of solid material within which is enclosed a fluid. Further details of the structure are also described. The solid can be separated from the fluid by gentle pressure. The composition of the two phases was determined in the case of the agar-water mixture for different proportions of the components and for different temperatures, and was found to vary with both of these conditions, a fact seemingly inconsistent with the phase rule, to account for which hypotheses are sug-

gested by the author. The composition of the phases was also found to depend greatly on whether the final temperature was reached from a higher or lower temperature, there being a marked lagging effect.

Vapor-Pressure Relations in Mixtures of Two Liquids, I and II. BY A. ERNEST TAYLOR. *J. Phys. Chem.*, **4**, 290-305 ; 355-369.—These papers describe an experimental investigation of the vapor-pressure of mixtures of acetone and water at various temperatures, and of the composition of the vapor from such mixtures. Part I is devoted to a description of the apparatus and methods employed. The main feature of the vapor-pressure method, which consisted in determining the boiling-point under measured pressures, is considered to be the arrangements for the avoidance of superheating ; a large quantity of a mixture of garnets with scrap platinum or with silver tetrahedra was placed in the boiling vessel, and this was submerged, up to the level of the liquid within, in a water-bath kept 8° above the boiling-point. The composition of the vapor was determined in a separate operation by distilling off 20 cc. from a 220 cc. portion of the mixture, and determining the boiling-point of this distillate under atmospheric pressure. Part II contains the experimental results together with their graphical representations and reductions of them for even temperatures and pressures. The boiling-points of pure water and acetone and of mixtures of them varying successively by 10 per cent. in composition, were determined at a large number of different pressures lying between 115 mm. and 715 mm. The composition of the distillate was determined for each mixture at two pressures, 200-250 mm. and 740 mm. The discussion of the results is reserved for a third paper.

On the Determination of Transition Temperatures. BY H. M. DAWSON AND P. WILLIAMS. *J. Phys. Chem.*, **4**, 370-382.—In order to determine the transition temperature of hydrated salts, the authors have measured in the neighborhood of the temperature, instead of the composition, the *density* and *electrical conductivity* of solutions saturated with each of two solid phases, and by plotting the results have tried to locate the point of intersection of the two curves. The property of density was shown to give entirely satisfactory results with sodium sulphate ; but this was not true of the electrical conductivity, for in such concentrated solutions this property changes very slowly with the concentration. This gives good results with less soluble salts, however ; as was shown by experiments with sodium sulphate. Incidentally an apparatus is sketched and described for the determination of the conductivity of hot saturated solutions ; and

the transition temperatures of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$, $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$, and $\text{Th}(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ are determined to be 32.38° , $58^\circ\text{--}59^\circ$, and $47^\circ\text{--}48^\circ$.

The Allotropic Forms of Selenium. BY A. P. SAUNDERS. *J. Phys. Chem.*, 4, 423-513.—The larger part of this lengthy paper is devoted to a list of references to previous articles relating to the properties of the various forms of the element selenium, and to abstracts of those articles. The author concludes from his investigation that selenium exists in three distinct forms, the liquid (including vitreous, amorphous, and soluble selenium), the red crystalline form, and the gray crystalline or metallic form. The new experiments described consist first of a large number of dilatometric measurements, by which it is shown that the metallic form is the stable one up to 220° , where it melts, it showing no tendency below that temperature to go over into any other form; and that vitreous selenium remains for years unaltered at the ordinary temperature, but goes over into the metallic form at $60^\circ\text{--}80^\circ$, though occasionally it may, by rapid heating, be brought to 180° before changing. The results are then given of qualitative experiments on the effect of a large number of liquids on amorphous selenium, one group of them transforming it into the red crystalline form, another group, composed exclusively of nitrogen compounds, changing it into the metallic form, and the third group, consisting of water and aqueous solutions, having no influence. Experiments are also described which make it probable that the red crystals have an instable melting-point at $170^\circ\text{--}180^\circ$. Finally a critical consideration of previous results and of some experiments of his own leads the author to adopt as the most probable specific gravity values, 4.26 for the amorphous, 4.28 for the vitreous, 4.47 for the red crystalline, and 4.80 for the metallic form.

An Exposition of the Entropy Theory. BY J. E. TREVOR. *J. Phys. Chem.*, 4, 514-528.—The author claims to have given a rigorous mathematical deduction of the entropy principle without any reference to the properties of gases.

Entropy and Heat Capacity. BY J. E. TREVOR. *J. Phys. Chem.*, 4, 529-532.—The conclusion is reached that "a system's entropy, plus its heat capacity with reference to any reversible path, is equal to the change per degree, on the same path, of the system's store of heat."

The Relation of the Taste of the Acid Salts to Their Degree of Dissociation, II. BY LOUIS KAHLENBERG. *J. Phys. Chem.*, 4, 533-537.—The author attempts to confute the explanation

advanced by Richards (*this Rev.*, 6, 121) and the reviewer (*this Rev.*, 6, 73) of the fact that the sour taste of acids and acid salts is not proportional to the concentration of the hydrogen ions in their solutions. That the author has entirely failed to understand that explanation will be evident when it is stated that the experiment which he brings forward to disprove it consists in causing a hydrochloric acid solution, so weak as not to taste sour when tasted in the ordinary manner, to remain long in motion in contact with the tongue, with the result that no sour taste is thereby developed.

The Eighth Group of the Periodic System and Some of Its Problems. BY JAMES LEWIS HOWE. *Proc. Am. Assoc. Advancement Sci.*, 49; *Science*, 12, 20-34.—This paper is a vice-presidential address in which the history of our knowledge of the platinum metals and their compounds is briefly presented.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

VOL. VI. NO. II.

ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and F. G. Moore; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and M. L. Fuller; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

ANALYTICAL CHEMISTRY.

ULTIMATE ANALYSIS.

H. P. TALBOT, REVIEWER.

A Process for the Determination of Carbon Dioxide in Carbonates. BY R. E. DIVINE. *J. Am. Chem. Soc.*, **22**, 473-476. The apparatus prescribed is of simple construction, including only two flasks with easily obtainable accessories. The air is expelled from one of the flasks by filling it with steam, and after cooling, the carbon dioxide liberated from the carbonate in the other flask, by means of sulphuric or tartaric acid, is collected in the first-named flask. Barium hydroxide solution is then introduced, and, after shaking to absorb the carbon dioxide, the excess of the hydroxide is determined.

A Method for the Rapid Gravimetric Estimation of Lime. BY W. H. HESS. *J. Am. Chem. Soc.*, **22**, 477-478.—The lime is precipitated as oxalate; this precipitate is ignited to destroy the filter, and the residue treated with ammonium nitrate and ammonium sulphate. Heating is continued until ammonium salts are expelled, and the lime is weighed as sulphate.

Note: The Employment of Ammonium Molybdate as a Test for Tin. BY J. P. LONGSTAFF. *J. Am. Chem. Soc.*, **22**, 450-451.—The author points out that he had already published a paper on this subject (*Chem. News*, **79**, 282) prior to the publication of Rogers' article (*J. Am. Chem. Soc.*, **22**, 220). The work of the two chemists is in substantial agreement.

Note: The Adulteration and Analysis of the Arsenical Insecticides. BY J. K. HAYWOOD. *J. Am. Chem. Soc.*, **22**, 568-582.

— The paper contains a résumé of the results of the analyses of the important insecticides of this class, and a description of methods of analysis which have given satisfactory results in the author's hands.

Note: Qualitative Tests for Boracic Acid. BY E. M. WADE AND M. L. WADE. *J. Am. Chem. Soc.*, **22**, 618.—The substance to be tested is treated with hydrochloric acid and wood alcohol, the solution concentrated, and turmeric paper is held in the vapors. The paper, upon treatment with dilute ammonia, turns deep purple or blue.

F. J. MOORE, REVIEWER.

Estimation of Alkali Carbonates in the Presence of Bicarbonates. BY FRANK K. CAMERON. *Am. Chem. J.*, **23**, 471-486.—The author finds existing methods unsatisfactory, and recommends that such solutions be titrated with a solution of acid potassium sulphate. Certain precautions are necessary in order to obtain a satisfactory end-point, owing to the instability of bicarbonates in solution. The method has the practical advantage that alkali and chlorine may be determined in the same sample.

Silicon in Ferrosilicon, II. BY FRED. W. BAUER. *Iron Age*, **65**, (No. 22) 11.—The author compares six methods for the determination of silicon in ferrosilicon, and reaches the conclusion that methods involving the fusion of the sample with sodium carbonate should be abandoned, as yielding too low results.

The Assay of Antimony. BY ARTHUR CHIPPENDALE. *Eng. Min. J.*, **69**, 553.—Native oxides of antimony are readily dissolved by boiling in concentrated hydrochloric acid, with the occasional addition of crystals of potassium iodide. In the solution the antimony may be determined by familiar methods.

The Electrolytic Determination of Copper. BY WILLIAM E. GRAINGER. *Eng. Min. J.*, **69**, 558.—The article gives an account of the methods by which ores are prepared for analysis at the laboratory of the "Ducktown Copper and Iron Co. Limited." The arrangement of their electrolytic apparatus is also described.

Separation and Determination of Mercury as Mercurous Oxalate. BY C. A. PETERS. *Am. J. Sci.*, **149**, 401-406.—The author sums up the results of his work as follows: "Mercurous nitrate may be estimated volumetrically by precipitating as oxalate and determining the excess of precipitant with permanganate. The precipitated mercurous oxalate may be estimated gravimetrically, by drying over sulphuric acid and weighing directly." Separations of mercurous salts from small quantities of

mercuric compounds may also be made, but the difficulties increase with the amount of mercuric salts present.

On the Qualitative Separation of Nickel and Cobalt by the Action of Ammonium Hydrate on the Ferricyanides. By PHILIP E. BROWNING AND JOHN B. HARTWELL. *Am. J. Sci.*, 150, 316-317.—The method of Clarke (*Am. J. Sci.*, 48, 67) is improved by the addition of the solution of an aluminum salt.

Iodometric Estimation of Arsenic Acid. By F. A. GOOCH AND JULIA C. MORRIS. *Am. J. Sci.*, 150, 151-157.—Soluble arsenates are treated with sulphuric acid and potassium iodide in slight excess. The bulk of the liberated iodine is expelled by boiling, and the solution finally bleached by the careful addition of sulphurous acid. After neutralization with sodium hydrate and acid carbonate, the resulting arsenite is titrated with iodine solution in the usual way. Earlier methods based upon the same reaction are critically discussed.

HENRY FAY, REVIEWER.

Note on a Qualitative Test for Tin. By CHARLES BASKERVILLE. *J. Elisha Mitchell Sci. Soc.*, 16, 80-81.—The test involves the application of Longstaff's method, which depends upon the blue color produced when stannous chloride reacts with molybdic acid. Compare the abstract above relating to the same subject.

J. F. NORRIS, REVIEWER.

The Elementary Analysis of Organic Substances Containing Nitrogen. By FRANCIS GANO BENEDICT. *Am. Chem. J.*, 23, 334-353.—In order to prevent the formation of oxides of nitrogen in the combustion of organic substances containing nitrogen, the compound to be analyzed is burned with a known weight of sugar or benzoic acid. After the substance has been charred in the closed tube, oxygen is admitted to oxidize the non-volatile residue and the copper that has been reduced by the volatile products of the dry distillation. The results of a large number of analyses made under these conditions prove that no oxides of nitrogen, which interfere with accurate results, are formed. The method does away with the use of a reduced copper spiral and so facilitates the analysis of nitrogenous substances. The use of sugar or benzoic acid in the analysis of compounds containing nitrogen which is not united to oxygen, is not necessary, for they can be burned without the formation of oxides of nitrogen, if they are charred, in the manner described above, before oxygen is admitted to the tube. The analysis of a compound containing a number of nitro groups can be readily effected by mixing the sub-

stance with finely powdered silica. The silica not only prevents an explosion, but also materially assists in reducing the oxides of nitrogen formed.

INORGANIC CHEMISTRY.

HENRY FAY, REVIEWER.

On the Isomorphism of Selenium and Tellurium. BY JAMES F. NORRIS AND RICHARD MOMMERS. *Am. Chem. J.*, **23**, 486-494.—The isomorphism of the double bromides of selenium and dimethylamine with the corresponding tellurium compound was studied by bringing together in succession saturated solutions of these two colored salts with the colorless double chloride of tellurium and dimethylamine. According to the method of Retgers, isomorphism exists when the color of the crystals varies gradually from one side to the other, the crystals of the pure compounds being visible on the extreme edges of the mass. If, however, the salts are not isomorphous, they do not mix, and in the center where the two solutions have been brought together, distinct crystals of each compound may be seen, owing to their difference of color. The double chloride of tellurium and dimethylamine gave mixed crystals of varying depths of color with both the selenium and the tellurium double bromide, showing the isomorphism of both bromides with the chloride, and consequently with each other. As it has been suggested that tellurium salts are isomorphous with those of the platinum group of metals, the double bromide of platinum and dimethylamine was tested in the same manner, using again the double chloride of tellurium and dimethylamine. In this case the two compounds crystallized out separately, disproving the isomorphism of the platinum compound with those of selenium and tellurium. During the investigation the following double salts of tellurium were isolated: $3\text{TeCl}_4 \cdot \text{TeOCl}_2 \cdot 4(\text{CH}_3)_2\text{NH} \cdot \text{HCl} \cdot \text{H}_2\text{O}$, $\text{TeCl}_4 \cdot \text{TeOCl}_2 \cdot 2(\text{CH}_3)_2\text{NH} \cdot \text{HCl} \cdot \text{H}_2\text{O}$, $\text{TeCl}_4 \cdot 2\text{TeOCl}_2 \cdot 3(\text{CH}_3)_2\text{NH} \cdot \text{HCl}$, $\text{TeCl}_4 \cdot 2(\text{CH}_3)_2\text{NH} \cdot \text{HCl}$, $\text{TeBr}_4 \cdot 2(\text{CH}_3)_2\text{NH} \cdot \text{HBr}$. It is thus shown that tellurium, as well as selenium, forms double salts which contain the oxychloride of the metal. The first three salts can be considered as derivatives of the salt $\text{TeCl}_4 \cdot (\text{CH}_3)_2\text{NH} \cdot \text{HCl}$, in which a part of the tellurium tetrachloride has been converted into the oxychloride by the water in the solvent. Double salts of tellurium, analogous to the double salts of selenium and the perbromide of dimethylamine $(\text{CH}_3)_2\text{NH} \cdot \text{HBr}_2$, could not be obtained.

The Occurrence of Vanadium, Chromium, and Titanium in Peats. BY CHARLES BASKERVILLE. *J. Am. Chem. Soc.*, **21**,

706.—In the ash from three samples of peat, all presumably from Hyde Swamps, N. C., small quantities of titanium, chromium, and vanadium were found.

A Study of Certain Double Chromates. BY W. G. HAYWOOD. *J. Elisha Mitchell Sci. Soc.*, 16, 56–59.—By crystallizing solutions of the alkali carbonates with the alkali bichromates, the following salts were isolated: $\text{NaNH}_4\text{CrO}_4 \cdot 2\text{H}_2\text{O}$, $2\text{Na}_2\text{Cr}_4\text{O}$, $(\text{NH}_4)_2\text{CrO}_4 \cdot 4\text{H}_2\text{O}$, $3\text{K}_2\text{CrO}_4 \cdot \text{Na}_2\text{CrO}_4$, $\text{K}_2\text{CrO}_4 \cdot \text{MgCrO}_4 \cdot 2\text{H}_2\text{O}$. The properties of these salts were not studied.

On the Effect of Very Low Temperatures on the Color of Compounds of Bromine and Iodine. BY J. H. KASTLE. *Am. Chem. J.*, 23, 500–505.—In a previous paper (*this Rev.*, 6, 62) the author has shown that the color intensity of the halogens is in inverse ratio to their chemical activity, and that the halogen compounds which are least stable are the most highly colored. It was then assumed that the color of these compounds was due to dissociation. This idea is considered to be confirmed by the experiments described in the present paper. The following compounds were subjected to a temperature of -190° in a Dewar tube immersed in liquid air: Lead iodide, phosphorus pentabromide, phosphorus heptabromide, mercuric bromide, iodoform, benzene, dibromsulphonamide, tribromphenol bromide, and mercuric iodide. In each case the color of the compound became markedly lighter on cooling, the change being, in some cases, very decided. It would seem to be generally true that all colored substances become lighter on cooling to low temperatures, but the change of color cannot be due in all cases to the same causes which produce it in the bromides and iodides. By cooling simultaneously the yellow and red varieties of mercuric iodide, it was found that the yellow mercuric iodide became white or very pale yellow, and that the red changed to orange-yellow, from which facts the author concludes that the low temperature does not change the red variety to the yellow variety stable above 128° , but simply changes its color in a manner characteristic of other colored bromides and iodides.

On the Supposed Allotropism of Phosphorus Pentabromide. BY J. H. KASTLE AND L. O. BEATTY. *Am. Chem. J.*, 23, 505–509.—It has been found that the red crystals which have been supposed to be an isomeric form of phosphorus pentabromide are in reality phosphorus heptabromide. The two substances behave differently towards water. The yellow phosphorus pentabromide, when brought in contact with water, changes to the oxybromide and afterwards dissolves. The red heptabromide dissolves apparently without the production of the oxybromide

and gives a solution which has the color of bromine water, the color of which can be removed by carbon disulphide. It is further shown that heat is evolved when bromine is added to phosphorus pentabromide, and that by adding a small quantity of phosphorus tribromide to the red compound it is changed to the yellow compound according to the equation $\text{PBr}_7 + \text{PBr}_3 = 2\text{PBr}_5$. Phosphorus heptabromide has been obtained in the form of bright red, transparent, prismatic crystals which may be resublimed, but which give up bromine on standing in contact with bromine absorbents.

Notes on Gold-Sodium Chloride. BY LYMAN F. KEBLER. *J. Franklin Inst.*, **150**, 235-237.—The following varying percentages of gold have been found in five samples of commercial gold-sodium chloride: 21.29, 24.68, 26.13, 29.02, 32.91.

REVIEW OF AMERICAN CHEMICAL RESEARCH.

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ARTHUR A. NOYES, Editor.

REVIEWERS: Analytical Chemistry, H. P. Talbot and F. G. Moore; Biological Chemistry, A. G. Woodman; Carbohydrates, G. W. Rolfe; General Chemistry, A. A. Noyes; Geological and Mineralogical Chemistry, W. O. Crosby and C. H. Warren; Inorganic Chemistry, Henry Fay; Metallurgical Chemistry and Assaying, H. O. Hofman; Organic Chemistry, J. F. Norris; Physical Chemistry, H. M. Goodwin; Sanitary Chemistry, E. H. Richards; Industrial Chemistry, A. H. Gill and F. H. Thorp.

GENERAL AND PHYSICAL CHEMISTRY.

A. A. NOYES, REVIEWER.

The Precipitation of the Sulphides of Nickel and Cobalt in an Alkaline Tartrate Solution, together with an Investigation into the Nature of Certain Tartrates of these Metals. By O. F. TOWER. *J. Am. Chem. Soc.*, 22, 501-521.—The investigation is mainly a physico-chemical one. Nickel tartrate of the composition $\text{NiC}_4\text{H}_4\text{O}_6$, a solution of which is formed by digesting an excess of nickel hydroxide with cold dilute tartaric acid, was found, (1) by the freezing-point method, to have in 0.1 molar¹ solution a molecular weight nearly a third greater than that corresponding to the formula; (2) to have an exceptionally small electrical conductivity (at 0.01 molar concentration about one-third that of magnesium tartrate), which increases very rapidly with the dilution; and (3) to give rise, when nickel electrodes are placed in a 0.02 molar solution of it and a 0.1 molar one of nickel nitrate, to an electromotive force (0.048 volt), which corresponds to the presence of about 8 per cent. of the nickel in the form of its ions in the former solution. Corresponding measurements with potassium nickel tartrate, ($\text{K}_2\text{NiC}_8\text{H}_8\text{O}_{12}$), made by digesting nickel tartrate at 40° with potassium hydrogen tartrate and in other ways, showed an apparent molecular weight about one-third of that corresponding to the formula just given, a conductivity not very different from that of a sodium tartrate solution containing an equivalent amount of the alkali metal, and an electromotive force corresponding to the presence of only 0.2-0.3 per cent of nickel ions. All these facts are explained by the assumptions that the former salt exists largely as double molecules which are dissociated

¹ This word will be used in this Review, in accordance with the suggestion of Ostwald, to designate a concentration of one mol (one molecular weight in grams) per liter.

into Ni'' and $\text{O.CO.}(\text{CHOH})_2.\text{CO.O.Ni.O.CO.}(\text{CHOH})_2.\text{CO.O}''$ ions to a relatively small extent, and that the latter salt is almost completely dissociated into two K ions and this same complex nickel tartrate ion, this last ion being itself only very slightly dissociated at moderate dilutions, but appreciably so at very great dilutions. The author has also investigated the effect on the freezing-point of a neutral nickel tartrate solution of adding successive quantities of potassium hydroxide, but the results are so irregular, owing, perhaps, to the formation of a colloidal substance, which even separated as a jelly at one concentration, that the conclusions drawn from them in regard to intermediate compounds seem to the reviewer of little value. It may be mentioned, however, that when two mols of potassium hydroxide were added to one mol of $\text{NiC}_4\text{H}_4\text{O}_6$, the apparent molecular weight was found to be 185, while that corresponding to $\text{K}_2\text{C}_4\text{H}_2\text{NiO}_6$ is 283, thus showing that the double molecules in the pure nickel tartrate solution are finally resolved by the potassium hydroxide, as might be expected, into single ones, and that these are considerably dissociated. Electromotive-force measurements showed that nickel ions were not present in appreciable quantities in this solution.—Freezing-point and conductivity measurements in the case of the various corresponding cobalt compounds, gave analogous results. The conductivity of neutral cobalt tartrate in 0.06–0.02 molar solution is, however, nearly one-half greater than that of the nickel compound. Finally, the author shows that in the solution prepared by adding an excess of sodium hydroxide to nickel tartrate solution and saturating with hydrogen sulphide, nickel sulphide is probably present in the colloidal condition; for the solution polarizes light, and nickel sulphide is precipitated from it by the addition of gum-arabic and alcohol. The different behavior of cobalt, which is precipitated by the hydrogen sulphide, therefore arises merely from the much smaller tendency of its sulphide to remain in the colloidal condition. Villiers' method of separation, which is based on this difference of behavior, is regarded by the author to be unsatisfactory for several reasons.

The Relation between Structural and Magneto-optic Rotation. By A. W. WRIGHT AND D. A. KREIDER. *Am. J. Sci.*, 156, 416–427.—Experiments have been made by the authors to determine whether the molecular structure or aggregation to which optical activity is due is influenced by causing the chemical substance or crystals to be produced in a magnetic field, which itself, as is well known, imparts temporary activity to all substances. The results obtained were negative in all cases, it being found that *d*-tartaric acid was converted into the active forms at the same rate whether it was heated with water in a magnetic or in a neutral field, that racemic acid does not

become active when heated in a magnetic field, and that sodium chlorate does not show any increased tendency to crystallize in either the dextro- or laevorotatory form in a magnetic field. It was, however, found that both kinds of crystals of this substance, and that also crystals of ferrous sulphate have a marked tendency to form more abundantly in the strongest part of the field. It was also found, contrary to the previous experiments of Pope and Kipping (*Chem. News*, 75, 45), that the presence of an optically active substance (glucose) in the solution does not have any effect on the form of the sodium chlorate crystals produced.

Toxic Action of Acid Sodium Salts on *Lupinus Albus*. By LOUIS KAHLENBERG AND ROLLAN M. AUSTIN. *J. Phys. Chem.*, 4, 553-569.—It is found that the toxic effect of the acid sodium salts of oxalic, tartaric, malic, succinic, and citric acids, on seedlings of *Lupinus Albus*, increases with the extent of their dissociation into hydrogen ions, but is very far from proportional to the concentration of these, as is shown especially by a comparison with the effect of hydrochloric acid. As in the case of their sour taste (*this Rev.*, 6, 73), the physiological action of these salts is dependent, not only on the concentration of the hydrogen ions, but also on that of the salt as a whole.

Relationships between Thermodynamic Fundamental Functions. By J. E. TREVOR. *J. Phys. Chem.*, 4, 570-584.—The author derives a large number of equations expressing the relations between the four fundamental functions, energy, free energy, the heat function, and the thermodynamic potential, both for the case of a system of definite masses and for the individual phases.

The Boiling-points of Mixtures of Chloral and Water. By JOSEPH C. CHRISTENSEN. *J. Phys. Chem.*, 4, 585-597.—It is found that the addition of 5 per cent. of water to pure chloral causes a depression of its boiling-point by about 2°; about 5 per cent. more water then raises it to its original value; after which further additions raise the boiling-point very gradually to that of pure water, which is about 3° higher than that of pure chloral.

On the Emission and Absorption of Water Vapor by Colloidal Matter: Correction. By P. DUHEM. *J. Phys. Chem.*, 4, 598.—Two equations in the previous article with the same title (*this Rev.*, 6, 74) are stated to be incorrect.

On the Position of Helium, Argon, and Krypton in the Scheme of the Elements. By WILLIAM CROOKES. *Am. J. Sci.*, 156, 189-192.—The author points out that in his earlier

proposed arrangement of the elements (*J. Chem. Soc.*, 53, 502, 1888) at equi-distant intervals on an ascending curve of figure-eight horizontal projection, vacant spaces exist into which the new elements, helium, neon, argon, metargon, and krypton, are, in consideration of their properties, appropriately inserted.

H. M. GOODWIN, REVIEWER.

The Solution-tension of Zinc in Ethyl Alcohol. BY HARRY C. JONES AND ARTHUR W. SMITH. *Am. Chem. J.*, 23, 397-403.—From Kahlenberg's value of the electromotive force (0.195 volt) of the cell: $\text{Zn}, 0.1 \text{ N } \text{ZnCl}_2 \text{ alcoholic}, 0.1 \text{ N } \text{ZnCl}_2 \text{ aqueous}, \text{Zn}$ (see *this Rev.*, 6, 11), the authors calculate the value of the electrolytic solution-pressure of zinc in alcohol to be 1.9×10^{10} . From the same investigator's measurement of the absolute potential difference between zinc and a 0.1 normal alcoholic ZnCl_2 solution, 0.327 volt, the value is of the same order of magnitude, namely, 2.7×10^{10} . These calculations are based on a determination of the dissociation of ZnCl_2 in alcohol by the boiling-point method, which gave 6.5 per cent. for a 0.1 normal solution. The electrolytic solution-tension of zinc in water, as computed by Ostwald, is 10^{18} , thus about 10^8 times as great as the value in alcohol.

The Conductivity Temperature Coefficient of some Liquid Ammonia Solutions. BY EDWARD C. FRANKLIN AND CHAS. A. KRAUS. *Am. Chem. J.*, 24, 83-93.—Solutions of ammonium chloride, bromide, and iodide, of potassium iodide, of paranitrophenol, and of copper nitrate in liquid ammonia were sealed in thick-walled tubes provided with small platinum electrodes, and their molecular conductivity determined, over wide ranges of temperature. In all these cases, with rising temperature, the conductivity passed through a maximum. The same was found to be true for a solution of potassium iodide in methylamine. A solution of sulphur in ammonia showed a distinct conductivity at 139.5° , which is 6.5° above the critical temperature of ammonia. Solutions of potassium, sodium, and lithium in liquid ammonia have a positive temperature coefficient.

On the Electrolytic Deposition of Metals from Non-aqueous Solutions. BY LOUIS KAHLENBERG. *J. Phys. Chem.*, 4, 349-355.—Experiments were made on the deposition of silver from solutions of silver nitrate in pyridine, aniline, benzonitrile, quinoline, and acetone, and also on that of lead and antimony from non-aqueous solutions. Comparing the amount of silver deposited with that deposited in an ordinary silver voltameter connected in series with the electrolytic cell, it was found that the latter was uniformly higher, by nearly a per cent. in some cases. This discrepancy is

attributed to secondary reactions, as the silver-deposits from the non-aqueous solutions were usually discolored. It was found that silver could be completely separated electrolytically in compact form, from pyridine solutions, both pure and mixed with water. The work is stated to be only preliminary in character.

On the Weston Cell. BY H. T. BARNES. *J. Phys. Chem.*, **4**, 339-349.—The author has investigated a number of Weston cadmium cells of various construction with reference to the change in their temperature coefficients, which the experiments of Kohnstamm and Cohen on the inversion point of cadmium sulphate in the neighborhood of 15° would lead one to anticipate. Their experiments all show the temperature coefficient of these cells to agree remarkably well between 15° and 40° , and that they are expressed well by the formula $E_t = E_{15} - 0.086 (t - 15^{\circ})$. Between 0° and 15° different cells behave quite differently however, some of them showing an abrupt change in their temperature coefficient at about 2° , others between 8° and 15° , while still others showed no sudden change at all. The values of the electromotive force for different cells at 0° varied as much as two millivolts. The mean corrected ratio of the electromotive force of the Clark cells at 15° to that of the cadmium cells at 20° was found to be 1.40658, while Kahle gives the nearly identical value 1.40663. The reviewer would mention in this connection that Jaeger and St. Lindeck, of the Reichsanstalt (*Ztschr. phys. Chem.*, **35**, 98), have found cadmium cells containing a 13 per cent. amalgam wholly reliable above 10° , while Cohen (*Ztschr. phys. Chem.*, **34**, 621) claims they are unreliable below 23° . The concentration of the amalgam appears to have a decided influence on the constancy of the cells.

Electrolysis of Sodium Chloride. BY C. G. L. WOLF. *J. Phys. Chem.*, **4**, 200-206.—The article describes a convenient apparatus for the electrolysis of solutions evolving gases at the electrodes, adapted for the laboratory and lecture room. The gases are separately collected, the apparatus kept at a uniform temperature in a thermostat, and the solution stirred. Its use is illustrated by an experiment on the electrolysis of sodium chloride.

A Chromium Cell for the Rectification of Alternating Currents. BY J. LIVINGSTON R. MORGAN AND W. A. DUFF. *J. Am. Chem. Soc.*, **22**, 331-334.—An electrolytic cell containing a ten per cent. sulphuric acid solution, a strip of platinum foil as cathode, and a fragment of metallic chromium as anode, was found to prevent the passage of a continuous current, if the external electromotive force was *gradually* increased, until the latter reached a value of 75 volts. The polarization is broken down at

this voltage and a current passes from chromium to platinum in the cell. The chromium electrode, however, then acquires the property of polarizing in the reverse direction; *i. e.*, a current in the reverse direction will now no longer traverse the cell from platinum to chromium until a certain voltage (which appears variable) is reached, when the cell is again broken down, a reversal takes place, and the chromium again becomes capable of opposing 75 volts when acting as anode. This remarkable behavior the authors attribute to the chromium passing from the "active" to the "inactive" state (Hittorf). The experiment is interesting in connection with the recent beautiful investigations of Ostwald on the periodic phenomena observed on dissolving chromium.

Quantitative Lecture Experiments on Electrochemistry.

BY W. LASH MILLER AND FRANK B. KENRICK. *J. Phys. Chem.*, 4, 599-618.—The authors describe in detail the construction of a lecture room galvanometer of the d'Arsonval type, and accessories, suitable for illustrating quantitatively numerous electrochemical relationships. The index of the galvanometer is so arranged that it closes a circuit through a relay, if deflected to either side of its zero position. The relay, in turn, is caused to alter a variable resistance in one arm of the Wheatstone bridge arrangement, until the adjustment for zero deflection is produced. The resistance thus automatically adjusted is recorded on a large dial, graduated to give directly in ohms the resistance of the substance measured. Fifteen quantitative lecture experiments are described, illustrating Faraday's Laws, molecular conductivity, Ostwald's dilution law, isohydric solutions, electromotive force, and polarization. (Compare also Noyes and Blanchard, *J. Am. Chem. Soc.*, 22, 726.)

A New Bridge Arrangement for the Determination of Electromotive Force by Aid of the Lippmann Electrometer.

BY J. LIVINGSTON R. MORGAN. *J. Am. Chem. Soc.*, 12, 202-204.—The arrangement consists in connecting a constant battery in series with a slide wire bridge and a resistance box containing thirteen coils each of the same resistance as the bridge wire, and balancing the unknown electromotive force against the drop in potential through a portion of the bridge coils and fraction (setting) of the bridge wire. This arrangement can hardly be designated as new.

A New Electrolytic Cell for Rectifying Alternating Currents.

BY W. L. HILDBURGH. *J. Am. Chem. Soc.*, 22, 300-304.—This is a very neat device by which one-half the wave of an alternating current can be repressed and the current thus rectified. It consists of a large platinum electrode covered with platinum black, partly immersed in a sulphuric acid solution, and partly exposed to an atmosphere of hydrogen. The other electrode

dipping in the same solution is a small platinum-wire point sealed into a glass tube. The best size for the electrodes varies with the current. The whole cell is enclosed in an atmosphere of hydrogen. When a current passes from the large to the small electrode through the liquid, hydrogen goes into solution at the large cathode and an equal quantity is liberated at the anode. On reversing the current, the small point-electrode becomes the anode and the oxygen polarization prevents the passage of the current, provided the impressed electromotive force is not too great; in the latter case several cells are connected in series.

A Method for the Determination of Electrical Conductivity with Direct Current Instruments. BY J. LIVINGSTON R. MORGAN AND W. L. HILDBURGH. *J. Am. Chem. Soc.*, **22**, 304-307.—An alternating-current generator is connected in series with the electrolytic cell and a non-inductive resistance. Around the latter is shunted a galvanometer and a hydrogen cell for rectifying the alternating current (see preceding review). The deflection of the galvanometer is noted, and then a non-inductive resistance is substituted for the conductivity cell, and adjusted until the same deflection as before is indicated by the galvanometer. With the ordinary Kohlrausch electrolytic cell and an alternating voltage of two volts the authors state that the results agree satisfactorily with those obtained by the usual Kohlrausch method.

BIOLOGICAL CHEMISTRY.

A. G. WOODMAN, REVIEWER.

The Proteids of the Egg Yolk. BY THOMAS B. OSBORNE AND GEORGE F. CAMPBELL. *J. Am. Chem. Soc.*, **22**, 413-422.—Salt solutions dissolve from egg yolk a mixture of protein compounds with lecithin, containing from 15 to 30 per cent. of lecithin. This lecithin is not removed by ether, but readily by alcohol. The resultant lecithin-free proteid obtained by fractional precipitation has a constant composition. The conclusion drawn is that the protein of egg yolk is principally a lecithin compound, soluble in salt solutions, and in its behavior resembling a globulin.

The Protein Constituents of Egg White. BY THOMAS B. OSBORNE AND GEORGE F. CAMPBELL. *J. Am. Chem. Soc.*, **22**, 422-450.—In a previous paper (*this Rev.*, **5**, 110) Osborne described preparations of crystallized egg albumin which indicated that with the substance ordinarily known as ovalbumin there are associated other protein bodies. The authors have since repeated the work on a larger scale, confirming the earlier observations, and are able to present a number of facts concerning these and other protein substances.

The Nucleic Acid of the Embryo of Wheat and Its Protein Compounds. BY THOMAS B. OSBORNE AND GEORGE F. CAMPBELL. *J. Am. Chem. Soc.*, 22, 379-413.—The authors find that gliadin and glutenin, the principal proteid constituents of the endosperm of wheat, are not present in the embryo. The embryo does contain a nucleic acid different from any form as yet described, as well as leucosin, a globulin, and proteose. It is probable that the embryo contains a number of compounds formed by varying combinations of these protein substances with the nucleic acid.

On the Phosphorus Content of the Paranuclein from Casein. BY HOLMES C. JACKSON. *Am. J. Physiol.*, 4, 170-177.—The paranuclein obtained by digestion of casein with pepsin-hydrochloric acid is shown to contain considerable amounts of phosphorus in organic combination. The results of previous investigators, who found that the phosphorus recovered in the ash of their preparations was equivalent to the total phosphorus content of the paranuclein, are attributed to the high ash content of their products. When the latter is avoided, and thus the formation of inorganic phosphates during ignition is prevented, paranuclein yields over two per cent. of organic phosphorus.

On Uric Acid Formation after Splenectomy. BY LAFAYETTE B. MENDEL AND HOLMES B. JACKSON. *Am. J. Physiol.*, 4, 163-169.—The experiments of the authors indicate that the spleen is not the chief organ involved in uric acid production in the living body, and further, that it is doubtful if it plays any part whatever in this process. No diminution in uric acid production was observed in any case after splenectomy. They consider it improbable that the formation of uric acid in the mammalia can be assigned at present to any definite organ, or groups of organs.

The Occurrence and Origin of the Xanthine Bases in the Feces. BY WILLIAM H. PARKER. *Am. J. Physiol.*, 4, 83-89. From experiments on a healthy man of average body-weight the general conclusion is drawn that under normal conditions on a diet containing no nucleins there is always a constant excretion of combined xanthine bases derived from the cells of the alimentary canal. This excretion is increased to nearly double the usual amount when food containing nucleins or food rich in alloxuric bodies, as meat or meat extracts, is consumed. This increase is not necessarily due directly to the ingested food, but may arise indirectly from an influence exerted on the processes of metabolism and secretion.

An Experimental Study of Oxaluria, with Special Reference to Its Fermentative Origin. BY HELEN BALDWIN. *J. Expt. Medicine*, 5, 27-46.—The results of a number of experiments are given to show that in health no oxalic acid, or only a trace, is formed in the body, that present in the urine having been ingested with the food. In certain cases, however, in which free hydrochloric acid was absent from the gastric juice, it is considered that oxalic acid was formed in the organism itself, this formation being connected with fermentation in the alimentary canal.

On the Connective Tissue in Muscle. BY J. H. GOODMAN. *Am. J. Physiol.*, 4, 260-263.—In a recent paper describing a new method for the determination of connective tissue in muscle, Schepilewsky (*Archiv. für Hygiene*, 34, 348) speaks of the occurrence of mucin in muscle. The author has isolated and examined this so-called mucin. No carbohydrate could be obtained from it, and it was found to contain less than 0.01 per cent. of phosphorus and an average of 16.11 per cent. of nitrogen. These results indicate that the material is neither a glycoproteid nor a nucleoproteid. It resembles more closely the "*stroma substance*" obtained by von Holmgren from horse and rabbit muscle.

On the Occurrence of Iodine in Corals. BY LAFAYETTE B. MENDEL. *Am. J. Physiol.*, 4, 243-246.—The author has found considerable quantities of iodine, varying from 0.28 to 1.70 per cent., in three specimens of West Indian corals, and submits the results as additional evidence in favor of Drechsel's belief that for many organisms there is a specific iodine metabolism which is essential to the building up of the axial skeleton.

Glycogen Formation after Inulin Feeding. BY R. NAKASEKO. *Am. J. Physiol.*, 4, 246-250.—The well-known experiments of Miura (*Ztschr. für Biol.*, 32, 255) have been repeated, using large portions of inulin and allowing the absorption to proceed during longer intervals than before. In only three cases was an increase of glycogen in the liver above the starvation maximum observed, showing that the glycogen-forming properties of inulin must still be regarded as uncertain or minimal.

The Influence of Acids on the Amyolytic Action of Saliva. BY G. A. HANFORD. *Am. J. Physiol.*, 4, 250-260.—The author endeavors to show that contrary to the conclusions of Kubel (*Archiv. für ges. Physiol.*, 66, 276), it is impossible to point out any percentage of acid or alkali which inhibits salivary digestion in a definite degree. The character of the action is depend-

ent also upon the absolute amount of saliva and the variation in the quantity of proteid matter present. Whenever *free* hydrochloric acid is present a certain degree of inhibition is always the result.

Investigations on the Determination and Composition of Humus and Its Nitrification. BY CHARLES RIMBACH. *J. Am. Chem. Soc.*, 22, 695-703.—The author's experiments are a direct verification of the assumption previously made, that the *matière noire* of Grandeau is a definite source of nitrates through nitrification. In studying the Grandeau method for the determination of humus, it was found that soda solution extracts more nitrogen than does ammonia, but the question still remains, which of the two is the best solvent for humus substance, by which is understood the sum of all organic substances, decomposed or not, which are immediately available as plant food.

An Experimental Study of the Gas-producing Power of Bacillus Coli Communis under Different Conditions of Environment. BY MARY ENGLE PENNINGTON AND GEORGE C. KÜSEL. *J. Am. Chem. Soc.*, 22, 556-567.—*Bacillus coli communis* has been cultivated under the most nearly concordant conditions possible, and the gas produced has been examined chemically. The results obtained show great irregularity, but in general there seems to be an intimate relation between the production of hydrogen and nitrogen. The carbon dioxide is liberated in greatest quantity at the beginning of the fermentation.

On Certain Peculiarities in the Urine of Vegetarians. BY J. H. LONG. *J. Am. Chem. Soc.*, 22, 592-595.—The relation of uric acid to creatinin in normal urine is about 1 : 2; in the urines examined it was about 1 : 1.2. This is attributed to low food consumption and consequent low proteid metabolism. The observed distribution of reducing power shows that a vegetable diet, consisting largely of carbohydrates and fats, tends to increase the non-nitrogenous factors in the urine.

The Fractional Precipitation of the Globulin and Albumin of Normal Horse's Serum and Diphtheria Antitoxic Serum, and the Antitoxic Strength of the Precipitates. BY JAMES P. ATKINSON. *J. Expt. Medicine*, 5, 67-75.—The globulins of both normal and diphtheria antitoxic serum behave similarly toward chemical reagents. All of the diphtheric antitoxic power of both normal and immunized serum is always carried by the globulin and its fractional precipitates. During the fractional precipitation of the globulin some of it is lost and at the same time some of the antitoxic power of the globulin of the immunized serum is lost. These observations, together with the observed fact that

normal horse's serum contains an antitoxin which separates with the globulin, lead to the conclusion that "diphtheria antitoxin" is a form of globulin.

Adlumia Cirrhosa—A New Protopine-bearing Plant. BY J. O. SCHLOTTERBECK. *Am. Chem. J.*, 24, 249-253.—The roots of this plant have been found to contain about one per cent. of an alkaloid melting at 207° (corr.). Not enough of the alkaloid was obtained to make a combustion of it, but in its crystalline form, solubility, melting-point, and principal chemical reactions it agrees exactly with the *protopine* from *Bocconia cordata* and from opium. The author further considers it probable that protopine is identical with fumarine, the alkaloid of most frequent occurrence in the *Fumariaceae*.

Assay of Drugs by the Use of Living Plants. BY HENRY KRAEMER. *Am. J. Pharm.*, 72, 472-485.—From the results obtained it may be said generally that the rate of growth of certain plants in solutions containing toxic principles is inversely proportional to the toxicity of the solution. There seems to be a definite solution of alcohol or nux vomica alkaloids that is toxic, and with solutions containing different amounts of alcohol or nux vomica alkaloids there is a definite measure of growth depending upon the quantity present.

The Digestibility of Some Non-nitrogenous Constituents of Certain Feeding-stuffs. BY G. S. FRAPS. *J. Am. Chem. Soc.*, 22, 543-552.—The author has determined the digestibility of certain groups of the proximate constituents of various feeding-stuffs, and finds that the probable order of digestibility is: sugars, starches, pentosans, crude fiber, residual nitrogen-free extract, and pentosans in the crude fiber. The constituents of the nitrogen-free extract, in the order of digestibility, are: sugars, starches, pentosans, and residue.

The Digestibility and Nutritive Value of Bread. BY CHAS. D. WOODS AND L. H. MERRILL. *U. S. Dept. Agr., Expt. Sta. Bull.* 85, 1-51.—This bulletin is a report of progress in the extensive investigation undertaken to determine the effects of milling upon the resulting flours. The full discussion is reserved until further results are available. The work reported includes: digestion experiments with men in which bread formed the main diet; experiments upon the artificial digestion of bread with pepsin; a study of the income and outgo of nitrogen; a study of metabolic nitrogen in feces in a period with a diet of carbohydrates alone, and in a period of complete and in one of partial fasting; an investigation of the nutritive value of bread made with skim-milk as compared with that made from water; and experiments on the losses of material in baking bread.

Nutrition Investigations at the Cal. Agr. Expt. Station. By M. E. JAFFA. *U. S. Dept. Agr., Expt. Sta. Bull.* 84, 1-39.—Dietary studies have been made on a football team and on a chemist's family, and a number of dietary studies and digestion experiments have been made on infants. In one instance the metabolism of nitrogen by an infant has been studied. The studies of infants are especially interesting because of the meagerness of statistics in this line. The facts brought out show clearly the need for more study in this direction before definite conclusions can be drawn, especially with infants under one year old. The variations in the amount of protein show that there can be little comparison of the dietaries of infants under seven months old. From the seventh to the twelfth month there is more regularity, and after the first year the consumption is quite uniform.

The Wide Occurrence of Indicators in Nature. By G. S. FRAPS. *Am. Chem. J.*, 24, 271-276.—The results of the author's work show the very common occurrence of indicators in nature. Some seventy-four kinds of colored flowers and leaves were examined after extraction with water or dilute alcohol. In nearly every case the extract became one color when acid and another when alkaline. Some of the changes were very sharp, and, as a rule, the coloring-matter was fairly sensitive as an indicator, being changed by from less than 1 to 2 drops of tenth-normal ammonia.

The Nature of Commercial Sanguinarine Nitrate. By J. O. SCHLOTTERBECK. *Pharm. Rev.*, 18, 358-362.—Examination of several samples of commercial sanguinarine nitrate showed them to consist either of nearly pure chelerythrine, the methyl derivative of sanguinarine, or of a mixture of all the alkaloids of sanguinaria with more or less of its decomposition-products.

E. H. RICHARDS, REVIEWER.

Principles of Water Analysis as Applied to New Mexico Waters. By ARTHUR GOSS. *N. M. Agr. Expt. Sta., Bull.* 34, 55-106.—This bulletin gives tables of mineral contents of some 200 waters from different parts of the state, thus furnishing valuable data for future work. A case is given of the use of a water containing 440 parts of total solids per 100,000 without any inconvenience by those accustomed to it, though it was liable to cause severe illness in strangers. The usual limit of 57 parts for either potable or irrigation water cannot be adhered to in New Mexico.

G. W. ROLFE, REVIEWER.

On the Digestion and Assimilation of Pentosans and Furfuroids. By C. F. CROSS, E. J. BEVAN, AND J. S. REMINGTON.

J. Am. Chem. Soc., 22, 630-634.—Attention is drawn to the fact that no pentosan is really known to exist, and that there is no proof that the pentoses as such are actually in the plant, the balance of evidence pointing to their formation by oxidation of hexose compounds. In fact, the authors lead us to infer that the processes employed in the separation and identification of the pentoses may possibly be the cause of their formation, a point already made by others. On this account the authors propose to define these reputed compounds identified by the furfural reaction, as *furfuroids* (furfural-gebende substances) confining the name pentosan to the theoretical "pentose-anhydride" or the pentose analogue of starch. The results of experiments with cellulose hydrolysis products fed to rabbits show that almost the whole of these "furfuroids" were digested. This is which quite contrary to the result obtained in feeding pentose sugars, are known to be practically indigestible.

Sugar Beets, 1899. BY J. T. WILLARD AND R. W. CLOTHIER. *Bull. Kan. Sta. Agr. Col.*, 94, 49-55. **Experiments in the Cultivation of the Sugar Beet in Nebraska.** BY H. H. NICHOLSON AND T. L. LYON. *Bull. Neb. Agr. Expt. Sta.*, 60, 3-34. **Sugar Beet Investigations in 1899.** BY J. L. STONE AND L. H. CLINTON. *Bull. Cornell Univ. Agr. Expt. Sta.*, 182, 368-385. **Sugar Beets in Sanpete and Sevier Counties.** BY LUTHER FOSTER. *Bull. Utah Agr. Col. Expt. Sta.*, 63, 3-22. **Sugar Beets and Sorghum Investigations in 1899.** BY A. D. SELBY. *Bull. Ohio. Agr. Expt. Sta.*, 115, 175-192.—The titles sufficiently indicate the scope of these bulletins.

The Inversion of Cane Sugar in Various Pharmaceutical Preparations. BY A. H. WALTERSDORF AND W. O. RICHTMANN. *Pharm. Arch.*, 3, 81-94; 102-109.—The article describes an extensive investigation into the inverting effect of the ingredients of the more common syrups and elixirs on the sugar present in these preparations. The work was carried out under three temperature conditions representing the greatest, least, and average room temperatures.

ANALYTICAL CHEMISTRY.

PROXIMATE ANALYSIS.

A. G. WOODMAN, REVIEWER.

Estimation of Fat in Condensed Milk. BY ALBERT E. LEACH. *J. Am. Chem. Soc.*, 22, 589-591.—Twenty-five cc. of the diluted milk, corresponding to 10 grams of the original sample, are measured into a Babcock whirling-bottle. Water and

4 cc. of copper sulphate are added, and the precipitated proteids separated by the centrifuge. The supernatant solution of the sugar is withdrawn by a pipette, using a wisp of cotton over the tip as a filter, and the residue is washed twice with water, withdrawing it in each case with the pipette. Finally, enough water is added to make the volume approximately 17.6 cc., 17.5 cc. of sulphuric acid are added, and the process continued as in the ordinary Babcock method.

The Estimation of Fat in Sweetened Condensed Milk. By JOSEPH F. GEISLER. *J. Am. Chem. Soc.*, 22, 637-645.—The author discusses critically several methods which have been proposed for the estimation of fat in condensed milk and gives results to show the considerable time that is necessary to secure complete extraction in the Adams' coil method. Where only one gram of milk is used and the extraction is continued for four or five hours, fairly satisfactory results are obtained.

The Estimation of Fat in Sweetened Condensed Milk by the Babcock Test. By E. H. FARRINGTON. *Am. Chem. J.*, 24, 267-270.—17.6 cc. of the diluted milk is measured into a Babcock test-bottle, about 3 cc. of the usual sulphuric acid is added, and the bottle shaken vigorously. In order to compact the curd into a firm lump the bottle is whirled for about six minutes in a steam-heated turbine centrifuge, the temperature being kept at about 200° F. The sugar solution is poured off, the curd is shaken up with 10 cc. of water, 3 cc. of acid are added, and the bottles whirled as before. The sugar solution is again decanted, enough of the sugar being thus removed to prevent its interference with the regular test. The results are considered satisfactory, although the reviewer would point out that the error of multiplication, consequent upon dilution, seems greater than in some other methods proposed for the same determination.

The Detection of Coal-tar Dyes in Fruit Products. By A. L. WINTON. *J. Am. Chem. Soc.*, 22, 582-588.—The author has found Arata's wool test (*Ztschr. anal. Chem.*, 28, 639), most satisfactory for jellies, fruit juices, and sirups. In applying this test, 100 cc. of the liquid, prepared if necessary by boiling the substance with water, are boiled for ten minutes with 10 cc. of 10 per cent. solution of potassium bisulphate and a piece of wool, previously boiled out with dilute alkali, and washed. The wool is finally washed with boiling water and dried. The presence of certain coal-tar colors, chiefly of the azo group, may be ascertained by the dyeing of the wool.

The Adulteration and Analysis of the Arsenical Insecticides. By J. K. HAYWOOD. *J. Am. Chem. Soc.*, 22, 568-582.—The

arsenical insecticides most generally used are Paris green, Scheele green, London purple, arsenious oxide, lead arsenate, white arsenoid, pink arsenoid, green arsenoid, and parargene. These are adulterated in three ways: (1) By addition of some colored substance free from arsenic; (2) by addition of some inert material to increase weight; (3) by a decrease in the amount of combined arsenious oxide in the preparation. The methods for the determination of arsenious oxide in Paris and Scheele greens are compared and critically discussed.

GEOLOGICAL AND MINERALOGICAL CHEMISTRY.

C. H. WARREN, REVIEWER.

A New Meteorite from Oakley, Logan County, Kansas. By H. L. PRESTON. *Am. J. Sci.*, 160, 410-412.—The meteorite, which is the eleventh one reported from Kansas, weighed 61 lbs., 10 oz., and was $7\frac{1}{2} \times 10 \times 12$ in. in its greatest diameter. It consists of "olivine and enstatite chondrules imbedded in a very irregular ground mass of the same material, with numerous particles of iron and iron sulphides." An analysis gives its composition as follows: Metallic part, Fe, 12.76 per cent.; Ni+Co, 1.68 per cent.; silicates, 85.56 per cent.; total, 100 per cent.

Silicious Calcites from the Bad Lands of South Dakota. By S. L. PENFIELD AND W. E. FORD. *Am. J. Sci.*, 160, 352-354.—The crystals are rough in appearance but show with some distinctness characteristic calcite forms. In chemical composition the crystals resemble the silicious calcites from Fontainebleau, containing about 40 per cent. of calcite and 60 per cent. of sand. The sand grains at times attain the size of small pebbles. It appears that these crystals represent a phase of sand stone formation where the calcareous cement was able to crystallize and preserve its external crystalline form.

Cambrian Silurian Limonited Ores of Pennsylvania. By T. C. HOPKINS. *Bull. Geol. Soc. Am.*, 2, 475-502.—Extensive deposits of iron ores occur as irregular pocket-like deposits in the residual clays of the Cambro-Ordovician limestones and slates of Eastern and Central Pennsylvania. The ores consist of the hydrous oxides of iron, chiefly limonite, associated with manganese ores, wavellite, quartz, chert, and fluorite. The ores appear to have been derived from the original iron content of the limestones and slates, by a leaching and concentrating process in which carbonic and organic acids, together with oxygen took part. In position the ores favor the contact of the limestone and the underlying slate.

Two New Occurrences of Corundum in North Carolina. BY J. H. PRATT. *Am. J. Sci.*, 160, 295-298.—The first occurrence is in an amphibole schist, apparently a metamorphosed igneous rock of the gabbro type. The corundum is found in seams a few feet in width, and forms about 10 per cent. of the vein. The second is in a quartz schist, composed of biotite mica and quartz, in which the corundum is found along streaks or bands. It is thought that the excess of alumina contained in the original shales, which were afterwards metamorphosed into quartz schist, crystallized out along the planes of lamination.

Chemical Composition of Sulphohalite. BY S. L. PENFIELD. *Am. J. Sci.*, 160, 425-428.—Considerable doubt as to the existence of the mineral sulphohalite, recently described and assigned the formula $3\text{Na}_2\text{SO}_4 \cdot 2\text{NaCl}$, having arisen by reason of the failure of several investigators to make an artificial salt of like composition, the reinvestigation of the species described in this article was undertaken with the result that another constituent, fluorine, was discovered and the composition represented by the formula $2\text{Na}_2\text{SO}_4 \cdot \text{NaCl} \cdot \text{NaF}$ assigned to the mineral. It is interesting to note that the sulphohalite is associated with another triple salt, the mineral hanksite, $9\text{Na}_2\text{SO}_4 \cdot 2\text{Na}_2\text{CO}_3 \cdot \text{KCl}$.

Chemical Composition of Turquoise. S. L. PENFIELD. *Am. J. Sci.*, 160, 346-350.—The article records a reinvestigation regarding the chemical composition of turquoise. A new analysis was made on material exceptionally suitable for that purpose. From the results thus obtained the author shows conclusively that the mineral is to be regarded as a derivative of ortho-phosphoric acid in which the hydrogen atoms are largely replaced by the univalent, isomorphous radicals $\text{Al}(\text{OH})^{1}_2$, $\text{Fe}(\text{OH})^{1}_2$, and $\text{Cu}(\text{OH})^1$. The formula may be written $[\text{Al}(\text{OH})^{1}_2, \text{Fe}(\text{OH})^{1}_2, \text{Cu}(\text{OH})^1, \text{H}]_3\text{PO}_4$. The radical $\text{Al}(\text{OH})^{1}_2$ always predominates. A careful consideration of former analyses shows them to be in close agreement with the results just mentioned and wholly disprove's Clark's interpretation that turquoise is a mixture of the molecule $\text{Al}_2\text{HPO}_4(\text{OH})_4$ with finely divided iron and copper phosphates as impurities.

Scapolite Rocks from Alaska. BY J. E. SPURR. *Am. J. Sci.*, 160, 310-315.—The first rock described is an andesine-oligoclase-scapolite-biotite rock of granitoid texture, occurring in the form of great dikes cutting through an older igneous rock of granite and diorite. The scapolite is considered the equivalent of a feldspar in the rock and the latter is placed parallel to the belugite group of feldspar rocks as a scapolite belugite. The name yentnite is suggested, and the type becomes a biotite yentnite. A local variation of this rock is described as microcline

scapolitic. The second rock, a light-colored dike rock cutting cretaceous shales and limestones, is described as a quartz-scapolite porphyry, and is placed parallel to the quartz monzonite group of feldspar rocks. It is given the name of Kuskite. The author is of the opinion that gases—chlorine, etc.—played an important part in the formation of the scapolite; but he considers the latter to be undoubtedly an original constituent and not of secondary origin, as is probably the case with the Norwegian scapolite rocks.

Graftonite, a New Mineral from Grafton, N. H., and Its Intergrowth with Triphylite. BY S. L. PENFIELD. *Am. J. Sci.*, 160, 20-32.—The new mineral occurs in a coarsely crystalline pegmatitic vein of quartz and feldspar. Its composition as shown by chemical analysis is represented by the formula $R''_3P_2O_8$, where R'' represents the isomorphous elements—iron, manganese, and calcium—in varying proportions. This places it in the rare group of anhydrous, normal phosphates of which triphylite is also a member. The latter occurs in thin, dark layers, distinctly interlaminated with the light-colored graftonite. Microscopical examination brings out the interesting fact that the two minerals have a definite crystallographic orientation with respect to each other. Apparently, graftonite, which constitutes something over two-thirds of the whole mass, was in sufficient quantity to give its own monoclinic symmetry to the crystals and at the same time by reason of some similarity of molecular structure, has caused the laminæ of the orthorhombic triphylite to take a definite crystallographic orientation. These relations and the crystal habit are shown by appropriate drawings.

The Action of Ammonium Chloride upon Natrolite, Scolecite, Prehnite, and Pectolite. BY F. W. CLARKE AND GEORGE STEIGER. *Am. J. Sci.*, 160, 345-351.—The present paper is one of a series having for an object the study of the chemical constitution of certain silicates. The minerals were subjected to the action of ammonium chloride in sealed tubes at a temperature of 350° , and the resulting products analyzed. The action of a boiling 25 per cent. solution of sodium carbonate was also tried on them. Both natrolite and scolecite are unattacked by the sodium carbonate solution and yield with the ammonium chloride the same compound, $(NH_4)_2Al_2Si_3O_{10}$, which is a simple replacement of the bases and acid hydrogen of the minerals by the (NH_4) radical. From these facts and an entirely new and complete analysis it is concluded that the two minerals are salts of the same silicic acid, $H_8Si_3O_{10}$, and that their formulæ should be written $Na_2Al_2Si_3O_{10} \cdot 2H_2O$ for natrolite, and $CaAl_2Si_3O_{10} \cdot 3H_2O$ for scolecite, instead of the previously accepted orthosilicate formulæ

$\text{Al}_2(\text{ClO}_4)_3\text{Na}_2\text{H}_4$ and $\text{Al}_2(\text{SiO}_4)\text{CaH}_4\cdot\text{H}_2\text{O}$, respectively. Prehnite suffers no change when treated as above and is therefore of different structure. Pectolite, a metasilicate, $\text{NaHCa}_2\text{Si}_3\text{O}_8$, although attacked strongly by the chloride, did not yield results leading to any new or more definite conclusions as regards its structure.

Review of American Chemical Research.

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